SELECTED

SWATERRESOURCES ABSTRACTS



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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey U.S. Department of the Interior

VOLUME 20, NUMBER 6 JUNE 1987

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The Secretary of the Interior has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1987.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

S elected Water Resources Applications, includes abstracts of current and earlier journal, includes abstracts of current and earlier reports, and elected Water Resources Abstracts, a monthly pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the Water Resources Thesaurus. The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific Information Center U.S. Geological Survey MS 425 National Center Reston, VA 22092

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1. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

ANION EXCLUSION DURING TRANSPORT THROUGH THE UNSATURATED ZONE, Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research. For primary bibliographic entry see Field 2G. W87-04399

APPLICATION OF REVERSE-PHASE H.P.L.C. FOR THE DETERMINATION OF PARTITION COEFFICIENTS, Shell Internationale Research Mastschappij N.V., The Hague (Netherlands).
For primary bibliographic entry see Field 5A.
W87-04618

2. WATER CYCLE

2A. General

REVIEW OF RELATIONSHIPS BETWEEN GEOPHYSICAL FACTORS AND HYDROLOGI-CAL CHARACTERISTICS IN THE TROPICS, Office de la Recherche Scientifique et Technique Outre-Mer, Paris (France). Lab. d'Hydrologie. P. L. Dubreuil.

P. L. Dubreuil.

Journal of Hydrology JHYDA7, Vol. 87, No. 3/4, p 201-222, October 30, 1986. 1 fig, 8 tab, 31 ref.

Descriptors: *Reviews, *Tropical hydrology, *Geophysics, *Hydrological properties, *Tropic zone, *Tropical regions, *Rainfall-runoff relationships, Catchment areas, Runoff volume, Flood peak, Floods, Soil-water-plant relationships, Drain-

The hydrological behavior of catchments of different sizes and in various environments was explained through geophysical factors that distinguish them. In this review paper an inventory was made of the research work of French hydrologists in tropical regions over the last 30 years. Many hydrological studies were carried out for different sizes of catchment and periods of time. They dealt with runoff volumes, flood peaks and flood paterns. The most significant geophysical factors. with runoff volumes, flood peaks and flood patterns. The most significant geophysical factors were identified, and their influence upon hydrological characteristics were determined. General formulae and relationships were suggested. Key roles were played by: the soil-vegetation complex, which affects rainfall-runoff transformation; and the drainage area and the slope index, which affect rainfall-runoff transformation; and the drainage area and the slope index, which affect various ranges of catchment sizes was made in order to better understand the effects of geophysical factors upon hydrological phenomena; the change in size alters the nature or the intensity of these effects. (Author's abstract)

NONISOTHERMAL EMISSIVITY AND ABSORPTIVITY FORMULATION FOR WATER National Center for Atmospheric Research, Boul-

National Center of the Control of the Control of Control of Control of Geophysical Research (D) JGRDE3, Vol. 91, No. 8, p 8649-8666, July 20, 1986. 16 fig, 4 cash 27 ref, append. NASA Grant L9477B.

Descriptors: *Model studies, *Water vapor, *Emissivity, *Absorptivity, *Troposphere, *Mathematical equations, *Mathematical studies, Stratosphere, Planck function, Transfer equations.

Nonisothermal H2O emissivity (E) and absorptivity (A) formulations for the troposphere and the stratosphere are introduced. The nonisothermal effects arise from the wavelength integration of the Planck function, evaluated at the emitting level temperature (Te), with the monochromatic absorption evaluated at the temperature of the absorbing

path (Tp). Te and Tp can differ by as much as 20-30 K in the atmosphere. A nonisothermal emissivity that satisfies the constraints posed by the monchromatic form of the transfer equation for a nonisothermal atmosphere was formulated. The new formulations employ continuous analytical expressions for E and A that retain the following H2O radiative properties: the asymptotic properties at small and large pathlengths; temperature dependence of line parameters; nonisothermal effects; the e- and p-type continuum in the 500-1200/cm region; and the overlap of the e-type continuum with the H2O line absorption. The E and A expressions are derived from a set of reference 5/cm narrow-band calculations for homogeneous atum with the H2O line absorption. The E and A expressions are derived from a set of reference 5 / cm narrow-band calculations for homogeneous atmospheres. When applied to the inhomogeneous atmosphere including arctic, mid-latitude, tropics, and antarctic atmospheres, the cooling rates from 0 to 40 km computed from the emissivity approach agree within 3% of those from the narrow-band calculations; the surface downflux and the upflux at 50 km agree within 1.5%. A major fraction (>1/2) of these small errors are due to the strong-line approximation employed in the emissivity model for the 0.800 /cm and the 1200-2200/cm regions, and the emissivity approach itself introduces less than a 1% error in the fluxes. It was shown that emissivities, fluxes, and cooling rates computed by narrow-band models depend very strongly on the spectral resolution adopted in the model for computing transmittances. Thus the spectral resolution in the narrow-band model is an arbitrary parameter. Furthermore, by comparing the narrow-band model fluxes with line-by-line (LBL) calculations it was concluded that the 5/cm resolution model underestimates opacity due to inadequate treatment of the far wing opacity of lines. A simple continuum-type opacity was employed in the emissivity scheme into excellent agreement with available state-of-the-art LBL calculations. (Author's abstract) W87-04680

GENERALIZED STOCHASTIC HYDROME-TEOROLOGICAL MODEL FOR FLOOD AND FLASH-FLOOD FORECASTING: 1. FORMULA-

Iowa Univ., Iowa City. Dept. of Civil and Envi-ronmental Engineering. For primary bibliographic entry see Field 2E. W87-04968

GENERALIZED STOCHASTIC HYDROME-TEOROLOGICAL MODEL FOR FLOOD AND FLASH-FLOOD FORECASTING: 2. CASE

STUDIES, Iowa Univ., Iowa City. Dept. of Civil and Envi-ronmental Engineering. For primary bibliographic entry see Field 2E. W87-04969

SIMPLE MODEL FOR SPATIAL-TEMPORAL

PROCESSES, Stanford Univ., CA. Dept. of Statistics.

Water Resources Research WRERAQ, Vol. 22, No. 13, p 2107-2110, December 1986. 5 ref, 2

Descriptors: *Statistical methods, *Mathematical models, *Model studies, *Kriging, *Networks, Prediction, Spatial variation, Temporal variation.

A spatial-temporal process observed at a fixed network of sites at a number of observation times was modeled as the sum of a random field fixed in time plus a second independent random field fixed in time plus a second independent random field that varies both spatially and temporally. It was assumed that values of this second field taken at two different observation times are uncorrelated. Using this model, a simple expression for the kriging predictor of this process was obtained. This model also suggests a method of prediction of the average change in time in the process over a region. The simplicity of the model makes it clearly inapplicable in many situations. For example, the lack of spatial-temporal interactions makes the model inappropriate for many daily and weekly data sets. More complex models, are needed in these situations. (Alexander-PTT)

W87-04970

APPLIED CARRYING CAPACITY CONCEPT FOR INTEGRATING STORMWATER MAN-AGEMENT AND LAND USE PLANNING, A CASE STUDY: THE KUANTU PLAIN OF TAIPEI, TAIWAN,
National Chunghsing Univ., Taichung (Taiwan).
Graduate Inst. of Urban Planning.
For primary bibliographic entry see Field 4A.
W87-05003

2B. Precipitation

EXPERIMENTAL MONTHLY LONG-RANGE FORECASTS FOR THE UNITED KINGDOM: PART I. DESCRIPTION OF THE FORECAST-ING SYSTEM,

Meteorological Office, Bracknell (England). C. K. Folland, and A. Woodcock. The Meteorological Magazine, Vol. 115, No. 1371, p 301-318, October 1986. 12 fig. 15 ref.

Descriptors: "Weather data collections, "United Kingdom, "Weather forecasting, "Long-range forecasting methods, "Barometric pressure, "Rain-fall, Statistics, Temperature.

Changes in forecasting procedure instituted since the public service of long-range forecasts for the month ahead for the United Kingdom were discontinued in 1981 are described. The authors summarize the major changes in procedure and technique that have occurred since the public service ceased, together with an indication of the scientific ideas that currently guide long-range forecasting research. The potential value of long-range forecasts, structure of the monthly forecasts (illustrated with February 1986, one of the coldest Februarys on record), techniques used to make the forecast (statistical techniques for predicting average pressure at mean sea level (PMSL) and dynamical techniques in real-time long-range forecasting), and derivation of district temperature and rainfall forecasts from PMSL forecasts (Rochester-PTT)

RAIN-INDUCED DISPERSAL IN PUCCINIA ARACHIDIS, STUDIED BY MEANS OF A RAINFALL SIMULATOR, Office de la Recherche Scientifique et Technique Outre-Mer, Abidjan (Ivory Coast). Lab. de Phyto-

pathologic. S. Savary, and J. L. Janeau. Netherlands Journal of Plant Physiology NJPPAM, Vol. 92, No. 4, p 163-174, 1986. 2 fig, 4

Descriptors: *Simulated rainfall, *Plant diseases, *Groundnuts, *Peanuts, *Rainfall intensity, *Puccinia arachidis, *Spore dispersal, Lesion scales, Canopy.

A rainfall simulator was used on groundant plots artificially infected with Puccinia arachidis to study urediniospore dispersal in relation to various amounts of rainfall. Several trapping methods were used to compare dry, splash, and drip dispersal caused by rain. The spore liberation mechanisms activated by rain and the flows of spores which they generate can be studied at the infected canopy or at the sporulating lesion scales. Two systems referring to these scales were considered in discussion of results. Dry dispersal seemed preponderant; the spore content of the lesions in the canopy was strongly reduced by rain. The present results indicate that light rain ahowers may promote disease dispersal, whereas heavy showers may inhibit it. W87-04387

INTERCEPTION OF RAINFALL IN A HEDGE-ROW APPLE ORCHARD, Bristol Univ. (England). Dept. of Agricultural Sci-

R. A. Calheiros de Miranda, and D. R. Butler. Journal of Hydrology JHYDA7, Vol. 87, No. 3/4, p 245-253, October 30, 1986. 5 fig, 2 tab, 27 ref.

Group 28—Precipitation

Descriptors: *Rainfall interception, *Mathematical equations, *Apple orchards, *Throughfall, *Stemflow, *Rainfall, *Canopy, Bristol, Interception loss, Storage capacity, Foliage density.

Measurements were made of incident rainfall during the summer of 1980 in a hedgerow orchard of Cox's Orange Pippen apple trees at Long Ashton Research Station, University of Bristol. Throughfall and stemflow under the crowns of apple trees were also presented for the 3-month period. The variability of throughfall under a single tree and between trees was assessed and person. The variability of throughfall under a single tree and between trees was assessed and equations to estimate interception loss, throughfall and stemflow from incident rainfall were given. During the period of assessment, the overall interception loss in the rows was about 15% of the incident rainfall. (Wood-PTT)

SPATIAL AND TEMPORAL CHARACTERISTICS OF HIGH-INTENSIVE RAINFALL IN NORTHERN TUNISIA, Lund Univ. (Sweden). Dept. of Water Resources

Engineering.
R. Berndtsson, and J. Niemczynowicz.
Journal of Hydrology JHYDA7, Vol. 87, No. 3/4, p 285-298, October 30, 1986. 7 fig, 2 tab, 15 ref.

Descriptors: *Rainfall patterns, *Urban hydrology, *Spatial variability, *Temporal distribution, *Rain-fall-runoff relationships, *Urban planning, *Cloud-bursts, *Rainfall, Tunisia, Arid climates, Semiarid

When dealing with urban design, it is essential to have knowledge of the magnitude of the spatial variability of abort high-intensive rainstorms. Most of the studies of high-intensive rainfall, conducted or the studies of migh-intensive rainfal, conducted during recent years, concerned regions with a humid climate. Still, the largest temporal and spa-tial variations in rainfall are to be found in arid and semi-arid regions. Findings regarding rainfall vari-ability, observed in a small catchment in northern abuny, observed in a small calciument in northern Tunisia during a 2 year period, were presented. Point and areal intensities were presented for the ten most high-intensive storms observed. Storm-centered areal reduction factors were calculated for different durations and areas. (Author's ab stract) W87-04400

EFFECT OF SIMULATED ACID PRECIPITA-TION ON SOIL MICROBIAL ACTIVITY IN A TYPIC QUARTZIPSAMMENT, Florida Univ., Gainesville. Dept. of Soil Science. For primary bibliographic entry see Field 5C.

EMPIRICAL RELATION BETWEEN SUL-PHUR DIOXIDE EMISSIONS AND ACID DEP-OSITION DERIVED FROM MONTHLY DATA, Environmental Defense Fund, New York. C. B. Epstein, and M. Oppenheimer. Nature NATUAS, Vol. 323, No. 6085, p 245-247, September 18, 1986. 2 fig. 2 tab, 13 ref.

Descriptors: *Sulfur dioxide, *Water pollution sources, *Weather data collections, *Acid deposi-tion, *Acid rain, *Atmosphere, *Weather, *Chem-istry of precipitation, *Path of pollutants, *Air pollution, *Rainfall, *Atmospheric physics, *Sulfur emissions, *Mathematical studies, Sulfates, Predic-tion, Regression analysis, Distribution, Monthly distribution.

The relation between sources of sulfur dioxide and precipitation sulfate concentrations at distant receptors is investigated to provide insight into the effectiveness of potential acid-deposition reduction strategies. Large variations in SO2 emissions from copper smetters in the southwestern United States, the major regional sulfur source, between 1980 and 1984, provide a unique opportunity to study the source-receptor relation. During this interval, the National Atmospheric Deposition Program (NADP) monitored wet-precipitation sulfate concentrations on a weekly basis at Rocky Mountain locations. An earlier analysis of annual-average data is extended by examining monthly sulfate

concentration and emission data for 1980-84. Monthly data are shown to be consistent with a linear relation between emissions and concentration, possessing the expected properties of a source-receptor relation. Concentration changes are predicted from the addition of a new smelter at Nacozari, Mexico, expected to be the second-largest source of SO2 in North America. (Author's abstract)

UNRAVELLING A CENTURY OF ACID POL-LUTION, For primary bibliographic entry see Field 5B. W87-04473

CELLULAR READJUSTMENT OF BARLEY SEEDLINGS TO SIMULATED ACID RAIN, Lancaster Univ., Bailrigg (England). Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C. W87-04474

ABNORMAL POLARITY OF THUNDER-CLOUDS GROWN FROM NEGATIVELY CHARGED AIR, New Mexico Inst. of Mining and Technology,

Socorro.
C. B. Moore, B. Vonnegut, T. D. Rolan, J. W.
Cobb, and D. N. Holden.
Science SCIEAS, Vol. 233, No. 4771, p 1413-1416,
September 26, 1986. 2 fig, 27 ref. NFS Grant
GA433.

Descriptors: *Polarity, *Clouds, *Weather, *Lightning, *Electrical studies, *Thunderclouds, *Thunderstorms, *Atmospheric physics, Optical properties, Storms.

Experiments were carried out in New Mexico to determine whether the electrification processes that lead to the formation of lightning in clouds are influenced by the polarity of the charges in the air from which the clouds grow. The normal, positive space charge in the sub-cloud air was reversed by negative charge released from an electrified wire suspended across a two-kilometer-wide canyon. suspended across a two-kilometer-wide canyon.
On more than four occasions when the clouds over
the wire grew and became electrified, they were of
abnormal polarity with dominant positive charges
instead of the usual negative charges in the lower
part of the cloud. The formation of these abnormally electrified clouds suggests that the electrification process in thunderclouds can be initiated
and its colorist description to the colorist colorist can be initiated. and its polarity determined by the small charges that are present in the atmosphere. (Author's ab-

ACID RAIN: NEW FEARS PROMPTED CLEANUP, For primary bibliographic entry see Field 5B. W87-04477

POLLUTED RAIN FALLS IN SPAIN, For primary bibliographic entry see Field 5C. W87-04478

EFFECTS OF MAGNESIUM AND CALCIUM EFFECTS OF MAGNESIUM AND CALCIUM FERTILIZATION, OZONE AND ACID MIST ON THE MINERAL NUTRITION, FROST RESISTANCE AND BIOMASS PRODUCTION OF YOUNG SPRUCE TREES (PICEA ABIES (L.) KARST) (EINFLUSS EINER DUENGUNG MIT MAGNESIUM UND CALCIUM, VON OZON UND SAUREM NEBEL AUF FROSTHAERTE, ERNAEHBUNGSZUSTAND UND BIOMASS-PRODUKTION JUNGER FICHTEN (PICEA ABIES (L.) KARST)), Munich Univ. (Germany, F.R.). Inst. fuer Systematische Botanik.
For primary bibliographic entry see Field 5C. W87-04489

RESPONSE OF THE ROOT SYSTEM OF PICEA ABIES (L.) KARST TO FERTILIZER AP-

PLICATION AND FUMIGATION OF THE SPROUT WITH OZONE AND ACID MIST (REAKTIONEN DES WURZELSYSTEMS VON PICEA ABIES (L.) KARST AUF MINERAL-STOFFERNAEHRUNG UND AUF BELASTUNG DES SPROSSES MIT OZON UND SAUREM

NEBELJ, Munich Univ. (Germany, F.R.). Inst. fuer Syste-matische Botanik. For primary bibliog:aphic entry see Field 5C. W87-04490

EFFECTS OF OZONE AND ACID MIST ON THE EPICUTICULAR WAX IN THE STOMATAL ANTECHAMBER OF NEEDLES OF PICEA ABIES (L.) KARST (EINFLUSS VON OZON UND SAUREM NEBEL AUF DIE STRUKTUR DER STOMATAEREN WACHSPERGIBEEN IN NEW NADEN LOON DIE FROPFEN IN DEN NADELN VON PICEA ABIES (L.) KARST), Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Botanik.

For primary bibliographic entry see Field 5C. W87-04491

INFLUENCE OF MINERAL NUTRITION, OZONE, AND ACID MIST ON PHOTOSYN-THETIC PARAMETERS AND STOMATAL CONDUCTANCE OF PICEA ABIES (L.) KARST (EINFLUSS VON MINERALSTOFFERNAEH-RUNG, OZON UND SAUREM NEBEL AUF PHOTOSYNTHESE-PARAMETER UND STOMATAERE LEITFAEHIGKEIT VON PICES ABIEA (L.) KARST), Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Physik. For primary bibliographic entry see Field 5C. W87-04492

EFFECT OF MINERAL NUTRITION, OZONE AND ACID MIST ON THE CONTENTS OF ADENINENUCLEOTIDES, INORGANIC PHOSPHATE AND CARBOHYDRATES IN NEEDLES OF PICEA ABIES (L.) KARST (EINFLUSS VON MINERALSTOFFERNAEHRUNG, OZON UND SAUREM NEBEL AUF DEN GEHALT AN ADENINNUCLEOTIDEN, ANORGANISCHEM PHOSPHAT UND KOHLENHYDRATEN IN NADELN VON PICEA ABIES (L.) KARST.

EARST), Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Botanik. For primary bibliographic entry see Field 5C. W87-04493

EFFECT OF MINERAL NUTRITION, OZONE AND ACID MIST ON PEROXIDASE ACTIVITY IN NEEDLES OF NORWAY SPRUCE, PICEA ABIES (L.) KARST (EINFLUSS VON MINERALSTOFFERNAEHRUNG, OZON UND SAUREM NEBEL AUF PEROXIDASE-AKTIVITAETEN IN FICHTENNADELN, PICEA ABIES (L.) KARST).

Gesellschaft fuer Strahlen- und Umweltforschung mb.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Toxikologie und Biochemie. For primary bibliographic entry see Field 5C. W87-04499

INFLUENCE OF MINERAL NUTRITION, OZONE AND ACID FOG ON ABSCISIC ACID AND INDOLE ACETIC ACID IN NEEDLES OF PICEA ABIES (L.) KARST (EINFLUSS VON MINERALSTOFFERNAEHRUNG, OZON UND SAUREM NEBEL AUF INDOLESSIGSAEURE UND ABSCISINSAEURE IN NADELN VON PICEA ABIES (L.) KARST), Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). For primary bibliographic entry see Field 5C. W87-04495

INFLUENCE OF MINERAL NUTRITION, OZONE AND ACID MIST ON THE MONOTERPENE PATTERN OF NEEDLES OF PICEA ABIES (L.) KARST (EINFLUSS VON MINERALSTOFFERNAEHRUNG, OZON UND

Precipitation—Group 28

SAUREM NEBEL AUF DAS MONOTERPEN-MUSTER DER NADELN VON PICEA ABIES (L.) EARST), Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl füer Botanik. For primary bibliographic entry see Field 5A. W87-04496

INFLUENCE OF MINERAL NUTRITION, OZONE, AND ACID MIST ON THE CONTENT OF THE FUNGITOXIC COMPOUND P-HYDROXYACETOPHENONE IN SPRUCE NEEDLES (PICEA ABIES (L.) KARST) (EINFLUSS VON MINERALSTOFFERNAEHRUNG, OZON UND SAUREM NEBEL AUF DEN GEHALT DER FUNGITOXISCHEN SUBSTANZ P-HYDROXY-ACETOPHENON IN FICHTENNA-DELN (PICEA ABIES (L.) KARST)), Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Botanik und Microbiologie. For primary bibliographic entry see Field 5C. W87-04497

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For primary bibliographic entry see Field 5C. W87-04498 CONTENTS OF CHLOROPHYLL AND THE

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SUCHUNGEN,
Technische Univ. Muenchen (Germany, F.R.).
Lehrstuhl fuer Bodenkunde.
For primary bibliographic entry see Field 5C.
W87-04499

EFFECT OF ARTIFICIAL ACID RAIN ON THE DEVELOPMENT OF FINE-ROOTS AND MY-CORRHIZAE OF NORWAY SPRUCE (EIN-FLUSS VON SAURER BEREGRUNG UND KALKUNG AUF DIE BIOMASSE UND MY-CORRHIZIERUNG DER FEINWURZELN VON FICHTEN), Munich Univ. (Germany, F.R.). Lehrstuhl fuer

For primary bibliographic entry see Field 5C. W87-04505

CHARACTERIZATION AND INVENTORY OF ECTOMYCORRHIZAE ON SPRUCE IN THE HOEGLWALD AND THEIR REACTION TO ACID PRECIPITATION (CHARAKTERISIER-UNG UND INVENTUR DER FICHTEN-MY-CORRHIZEN IM HOEGLWALD UND DEREN REAKTIONEN AUF SAURE BEREGNUNG), Munich Univ. (Germany, F.R.). Inst. fuer Systematische Botanik.

FOO primary bibliographic entry see Field 5C. W87-04506

EFFECT OF SIMULATED ACID RAIN AND LIMING ON NEMATODES (EINFLUSS DER SAUREN BEREGNUNG UND KALKUNG AUF DIE NEMATODENFAUNA),

Munich Univ. (Germany, F.R.). Zoologisches Inst. For primary bibliographic entry see Field 5C. W87-04507

EFFECTS OF EXPERIMENTAL ACID PRE-CIPITATION AND LIMING ON VIGOR, SPE-CIES ABUNDANCE, AND MINERAL NUTRI-TION OF GROUND VEGETATION IN A NORWAY SPRUCE STAND (AUSWIRKUNGEN VON SAURER BEREGNUNG UND KALKUNG AUF DIE VITALITAET, ARTENMAECHTIG-KEIT UND NAEHRSTOFFVERSORGUNG DER BODENVEGETATION EINES FICHTENBES-TANDEO. TANDES), Munich Univ. (Germany, F.R.). Lehrstuhl fuer Bodenkunde.

For primary bibliographic entry see Field 5C. W87-04508

SYNOPTICAL DISCUSSION OF RESULTS OF FIELD EXPERIMENTS ON THE INFLUENCE OF ACID DEPOSITION AND LIMING IN STANDS OF NORWAY SFRUCE (PICEA ABIES (L.) KARST (ZUSAMMENFASSENDE DISKUSSION DER ERGEBNISSE AUS EXPERIMENTELLEN FREILAND-UNTERSUCHUNGEN UEBER DEN EINFLUSS VON SAUREN NIEDERSCHLAEGEN UND KALKUNG IN FICHTENBESTAENDEN (PICEA ABIES (L.) KARST).

**RARSTN, Munich Univ. (Germany, F.R.). Lehrstuhl fuer Bodenkunde.
For primary bibliographic entry see Field 5C.
W87-04511

MESOSCALE STORM AND DRY PERIOD PARAMETERS FROM HOURLY PRECIPITATION DATA,
Battelle Pacific Northwest Labs., Richland, WA.

Battelle Pacific Northwest Laos, Richland, WA. J. M. Thorp. Atmospheric Environment ATENBP, Vol. 20, No. 9, p 1683-1689, September 1986. 4 fig. 3 tab, 6 ref. EPA Contract DE-AC06-76RLO 1830, Interagency agreement EPA-DW930059.

Descriptors: *Storms, *Weather data collections, *Water pollution sources, *Precipitation, *Acid rain, *Rainfall, Pollutants, National Weather Service, Northeastern United States, Acidic water, Precipitation scavenging, Air pollution.

Precipitation rate, storm duration and seasonal variation of precipitation amount are some of the parameters which could affect the deposition of pollutants that contribute to the acidity of lakes and streams. Hourly precipitation data from 89 first-order National Weather Service stations in the northeastern United States were used to define seasonal wet- and dry-period statistics. Mean values of regional storm and dry-period duration and of precipitation rates for storms and precipitation events for each season were calculated. Frequency distribution of regional storm and dry-period duration allow comparison of seasonal variations and characteristics. Such statistics serve as input parameters for studies and models in order to provide a better understanding of the deposition of acidic pollutants by precipitation. (Author's abstract) tion rate, storm duration and season W87-04512

TRAJECTORY ANALYSIS OF WET DEPOSI-TION AT WHITEFACE MOUNTAIN: A SENSI-

National Oceanic and Atmospheric Admin tion, Rockville, MD. Air Resources Labs. For primary bibliographic entry see Field 5B. W87-04513

ORGANIC ACIDS IN SPRINGTIME WISCON-SIN PRECIPITATION SAMPLES, Battelle Pacific Northwest Labs., Richland, WA. For primary bibliographic entry see Field 5B. W87-04514

FLUORIDE CYCLING IN NATURE THROUGH PRECIPITATION,

Bhabha Atomic Research Centre, Bombay (India). Air Monitoring Section. For primary bibliographic entry see Field 5B. W87-04515

MODEL OF SULPHATE PRODUCTION IN A CAP CLOUD AND SUBSEQUENT TURBU-LENT DEPOSITION ONTO THE HILL SUR-FACE,

University of Manchester Inst. of Science Technology (England). Dept. of Physics. For primary bibliographic entry see Field 5B. ter Inst. of Science and W87-04516

MODELING OF THE 1900-1980 TREND OF PRECIPITATION ACIDITY AT HUBBARD BROOK, NEW HAMPSHIRE, Massachusetts Inst. of Tech., Cambridge. Energy Lab.

For primar W87-04517 ary bibliographic entry see Field 5B.

DETERMINATION OF TRACE METALS IN RAIN WATER BY DIFFERENTIAL-PULSE STRIPPING VOLTAMMETRY, Antwerp Univ., Wilrijk (Belgium). Dept. of Chem-

nary bibliographic entry see Field 5A. W87-04518

ECONOMIC VALUE OF SEASONAL-PRECIPITATION FORECASTS: THE FALLOWING/PLANTING PROBLEM,

Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences. B. G. Brown, R. W. Katz, and A. H. Murphy. B. U. Brown, R. W. A.BZ, and A. H. Murphy. Bulletin of the American Meteorological Society BAMIAT, Vol. 67, No. 7, p 883-841, July 1986. 6 fig, 3 tab, 18 ref. NOAA Grant NA82AA-D-00042, NFS Grants ATM-8209713 and ATM-8507495.

Descriptors: *Precipitation, *Planting management, *Forecasting, *Weather forecasting, *Pallowing, *Rainfall, *Decision making, *Weather data collections, Local precipitation, Rain gages, Great Plains, National Weather Service, Predictions

The fallowing/planting problem is an example of decision making which can be sensitive to meteoriological information. Wheat farmers in the drier, western portions of the Great Plains must decide western portions of the Great Plains must decide each spring whether to plant a crop or to let their land lie fallow. Information that could be used to make this decision includes the soil moisture at planting time as well as a forecast of growing-season precipitation. Current seasonal precipitation forecasts issued by the National Weather Service have minimal economic value in such decision making. However, modest improvements in the quality of the forecasts would lead to large increases in value, and perfect information would possess great value. In addition, forecast value is found to be sensitive to changes in crop price and precipitation climatology. In particular, the shape of the curve relating forecast value to forecast quality is quite dependent on the amount of growing-season precipitation. (Author's abstract) W87-04521

LAKE RESOURCES AT RISK TO ACIDIC DEP-OSITION IN THE UPPER MIDWEST, Iowa Univ., Iowa City. Dept. of Civil and Envi-ronmental Engineering. For primary bibliographic entry see Field 5B. W87.04530

DETERMINATION OF ORGANIC AND INOR-GANIC ACID SPECIES IN THE ATMOS-PHERE AND IN RAIN-WATER BY ION CHRO-

PHERE AND IN RAIL-WALLER BY AND AN MATORGRAPHY,
Consiglio Nazionale delle Ricerche, Rome (Italy).
Ist. Inquinamento Atmosferico.
For primary bibliographic entry see Field 5A.

Group 2B—Precipitation

DETERMINATION OF NITRATE AND SUL-PHATE IN RAIN-WATER BY CAPILLARY ISOTACHOPHORESIS, Komenakeho Univ., Bratialava (Czechoslovakia). Inst. of Chemistry. For primary bibliographic entry see Field 5A. W87-04535

ALPINE TUNDRA SOIL BACTERIAL RE-SPONSES TO INCREASED SOIL LOADING RATES OF ACID PRECIPITATION, NITRATE, AND SULFATE, FRONT RANGE, COLORADO, U.S.A., Colorado Univ. at Boulder. Inst. of Arctic and Alpine Research. For primary bibliographic entry see Field 5C.

DYNAMIC CALIBRATION OF TIPPING BUCKET RAINGAUGES, Lund Univ. (Sweden). Dept. of Water Resources Engineering. Por primary bibliographic entry see Field 7B. W87-04557

SIMPLE AND EFFICIENT CONCEPTUAL CATCHMENT MODEL ALLOWING FOR SPA-TIAL VARIATION IN RAINFALL, Lund Univ. (Sweden). Dept. of Water Resources Engineering. For primary bibliographic entry see Field 2E. W87-04559

OPTIONS FOR FINANCING ACID RAIN CONTROLS, Georgia Univ., Athens. Inst. of Natural Resources. For primary bibliographic entry see Field 6C. W87-04568

ESTIMATING CATCHMENT WATER QUAL-ITY RESPONSE TO ACID DEPOSITION USING MATHEMATICAL MODELS OF SOIL ION EXCHANGE PROCESSES, Virginia Univ., Charlottesville. For primary bibliographic entry see Field 5C. W87-04587

WATER QUALITY OF AGRICULTURAL COASTAL PLAIN WATERSHEDS, Delaware Univ., Newark. Dept. of Agricultural Engineering. For primary bibliographic entry see Field 5B. W87-04625

STRATOSPHERIC CONDUCTIVITY VARI-ATIONS OVER THUNDERSTORMS, Washington Univ., Seattle. Space Sciences Div. R. H. Holzworth, K. W. Norville, P. M. Kintner, and S. P. Powell. Journal of Geonhysical Research (D) JGRDE3.

anu 3. F. Fower Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 12, p 13257-13263, November 20, 1986. 3 fig, 24 ref. NSF Grants ATM 8212283 and ATM 8411326; NASA Grant NAGW-724.

Descriptors: *Weather data collections, *Remote sensing, *Thunderstorms, *Stratospheric conductivity, *Storms, *Conductivity orariations, Lightning, Conductivity, Relaxation technique, Vector field measurements, Langmuir probe-impedance method, Stratosphere, Weather.

The first in-situ observation of variations in the electrical conductivity over thunderstorms at 26 km altitude are reported. The vector electric field, positive and negative polar conductivity, and optical lightning power/flash were measured by payloads on superpressure balloons in the southern hemisphere in early 1984. In 72% of the thunderstorms periods observed (or in 23 of 32 periods) there were clear cases of conductivity variations while the balloons were over the thunderstorms. Examples from two separate balloons at widely separated dates and locations showing both daytime and nighttime events were presented. The conductivity measurements are made with the relaxation technique, and the vector field measure-

ments are based on the double Langmuir probe high-impedance method. The positive and negative conductivity measurements vary independently and have a different temporal profile than the de electric field. The polar conductivity variations can exceed a factor of 2 at this altitude. In seven of the nine most intense thunderstorm events the total conductivity increased, while in only one of these nine events did it decrease (one event had no change). Implications of these observations for global current patterns are discussed. (Author's abstract)

KINETICS OF HYDROGEN PEROXIDE-SULFURITY) REACTION IN RAINWATER COLLECTED AT A NORTHEASTERN U.S. SITE,

Brookhaven National Lab., Upton, NY. Environmental Chemistry Div. Y. N. Lee, J. Shen, P. J. Klotz, S. E. Schwartz, and L. Newman.

and L. Newman. Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 12, p 13264-13274, November 20, 1986. 7 fig, 1 tab, 48 ref. DOE Contract DE-AC02-76CH00016.

Descriptors: *Water pollution effects, *Rainwater, *Rainfall, *Kinetics, *Chemical reactions, *Acid rain, *Precipitation, *Snowmelt, Long Island, Hydrogen ion concentration, Conductivity, Clouds.

The kinetics of the reaction of dissolved S(IV) with H2O2 was studied in freshly collected precipitation samples in order to examine whether there exist any important influences on this reaction from trace constituents present in natural atmospheric liquid water, that is, rainwater and snownelt. The kinetic study was carried out on over 300 freshly collected samples obtained at Brookhaven National Laboratory, Long Island, NY, during the period from October 1983 to September 1985. The second order rate constant which was determined using the precipitation samples covering pH range 3.3-5.6, was found to be linearly dependent on H(+) concentration, conforming to results previously obtained with purified water. The observed scatter in the rate constant is examined and discussed. The small negative bias observed on the kinetics of this reaction is not expected to exert an appreciable effect on the extent of atmospheric SO2 oxidation, especially under conditions in which the reagent concentrations are high, and the reaction tends to be complete within cloud lifetimes. The use of rate constants for this reaction, determined using purified water in numerical calculations and modeling, is therefore justified. (Wood-PTT)

ZONAL AND GEOGRAPHICAL DISTRIBU-TIONS OF CIRRUS CLOUDS DETERMINED FROM SAGE DATA,

PRUM SAGE DAFA, National Aeronautics and Space Administration, Hampton, VA. Langley Research Center. G.E. Woodbury, and M. P. McCormick. Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 2, p 2775-2785, February 20, 1986. 6 fig, 9 ref.

Descriptors: *Cirrus clouds, *Clouds, *SAGE, *Cloud distribution, *Remote sensing, *Weather data collections, Data interpretation, Tropopause, Tropics, Geographical distribution, Comparison studies.

An analysis using Stratospheric Aerosol and Gas Experiment (SAGE) data for the period February 1979 to November 1981 was performed to determine the spatial extent and frequency of occurrence of cirrus clouds over a large portion of the earth's surface. The effective field of view corresponding to the determined frequency was 100 sq km. A by-product of the study reveals the statistics of tropospheric observations opportunities for a limb-sounding satellite sensor by determining the percentage of times of successful penetration to a given height or depth below the tropopause. The results of the analysis showed that optically thick cirrus clouds form most often in the mid-latitudes and over the tropics, with a distinct minima near

the latitude bands of 20 deg-30 deg north and south. The zonally averaged latitudinal distributions of cirrus clouds observed by SAGE compared very well with the Nimbus 5 selective chopper radiometer (SCR) observations in shape but not in magnitude. SAGE showed about twice the magnitude of the SCR results. The percentage of tropospheric observational opportunities down to 7 km was as high as 60% in the upper latitudes. A geographical presentation of the SAGE results showed the growth and seasonal movement of high-cloud features were in good agreement with previous studies. (Author's abstract)

ESTIMATES OF NITRATE FORMATION IN RAIN AND SNOW SYSTEMS, Ford Motor Co., Dearborn, MI. For primary bibliographic entry see Field 5B. W87-04676

CHEMICAL AND MICROPHYSICAL STUDIES OF NONPRECIPITATING SUMMER CLOUD IN ONTARIO, CANADA, Atmospheric Environment Service, Downsview (Ontario). For primary bibliographic entry see Field 5B. W87-04677

RATE OF PRECIPITATION SCAVENGING OF NITRATES ON CENTRAL LONG ISLAND, State Univ. of New York at Stony Brook. Dept. of Mechanical Engineering. For primary bibliographic entry see Field 5B. W87-04678

TRANSPORT OF OZONE BETWEEN BOUNDARY LAYER AND CLOUD LAYER BY CUMULUS CLOUDS,
National Oceanic and Atmospheric Administration, Boulder, CO. Environmental Sciences Group.
G. K. Greenhut.
Journal of Geophysical Research (D) JGRDE3,
Vol. 91, No. 8, p 8613-8622, July 20, 1986. 8 fig. 5
tab, 18 ref. EPA Interagency agreement AD-13F2-641-O.

Descriptors: *Path of pollutants, *Transport, *Clouds, *Cumulus clouds, *Ozone, *Ozone transport, *Mathematical equations, Boundary layers, Cloud layers, Turbulence data, Statistical studies, Pennsylvania, Ohio.

Turbulence data obtained from 107 aircraft penetrations of isolated, nonprecipitating cumulus clouds over suburban and rural areas in the vicinity of Lancaster, PA and Columbus OH are used to derive statistical parameters associated with the transport of ozone to and from the underlying boundary layer. The parameters are determined by the difference in ozone concentration between the cloud layer and boundary layer. The total cloud flux, defined as the transport across a horizontal plane within a cloud due to mean and turbulent cloud motions, was determined. Cloud turbulence contributes about 30% to the total cloud flux. (Wood-PTT) W8T-04679

NONISOTHERMAL EMISSIVITY AND AB-SORPTIVITY FORMULATION FOR WATER VAPOR, National Center for Atmospheric Research, Boulder, CO. For primary bibliographic entry see Field 2A. W87.04680

SFERICS RATE IN RELATION TO THUNDER-STORM DIMENSIONS, McGill Weather Radar Observatory, Ste. Anne de Bellevue (Quebec). E. V. Cherna, and E. J. Stansbury. Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 8, p 8701-8707, July 20, 1986. 7 fig, 1 tab, 18 ref.

Descriptors: *Thunderstorms, *Sferics rates, *Remote sensing, *Electrical studies, *Sferics,

Precipitation—Group 2B

*Mathematical studies, Mathematical equations, Statistical studies, Weather, Wind shear, Case stud-

On the basis of data from three days in 1978, the relation between thunderstorm dimensions and electrical activity was investigated to determine the relative importance of thunderstorm size and thunderstorm environment on the steries rate. Steries users recorded occurrence, the services are considered. thunderstorm environment on the sferics rate. Sferics were recorded continuously by a wide band (100 + or - 50 kHz) crossed-loop radio direction finder located at the radar site; precipitation data during the corresponding period came from the radar volume scan. The number of sferics associated with specific storms and recorded in 5-min intervals varied from a few tens to a few thousands, depending on the dimensions of the source storm and on its distance from the sferics receiver. For four thunderstorm situations this variation was For four thunderstorm situations this variation we reduced to a small scatter, with standard deviation reduced to a small scatter, with standard deviations corresponding to factors of 1.17-1.47, by fitting the data with the appropriate derived empirical relation. For three of the four sets of data analyzed, there was a nearly linear relation between the sferics rate and the storm's area; for a supercell storm the relation was higher than linear. For thunderstorms between 50 and 300 km distant the number of recorded sferics decreased exponential, where forces of shout? a week 45 km. Thunderstorms. number of recorded sferies decreased exponential-ly, by a factor of about 2 every 45 km. Thunder-storm height appeared the dominant parameter de-termining the rate of electrical activity; the greater effect of thunderstorm height was found associated with a stronger wind shear in the 7.5-12 km layer. (Author's abstract) W87-04681

CHEMISTRY OF OH IN REMOTE CLOUDS AND ITS ROLE IN THE PRODUCTION OF FORMIC ACID AND PEROXYMONOSUL-

Harvard Univ., Cambridge, MA. Center for Earth and Planetary Physics. For primary bibliographic entry see Field 5B. W87-04682

ANALYSIS OF REMOTE MEASUREMENTS OF TROPOSPHERIC CARBON MONOXIDE CONCENTRATIONS MADE DURING THE 1979 SUMMER MONSOON EXPERIMENT

1979 SUMMER MONSOON EXPERIMENT (MONEX), Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences. G. M. Doherty, R. E. Newell, and H. G. Reichle. Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 9, p 9827-9839, August 20, 1986. 8 fig, 3 tab, 44 ref. NASA Grant NAG-1-92.

Descriptors: *Atmosheric analysis, *Path of pollut-ants, *Monsoons, *MONEX, *Carbon monoxide, *Remote sensing, Troposphere, Radiometry, Mixing ratios, Saudi Arabia, Arabian Sea, India.

Mixing ratios of tropospheric CO as measured by an aircraft-mounted radiometer over Saudi Arabia, the Arabian Sea, and northern India during May, exceptionally high CO levels were detected over Saudi Arabia, and strong horizontal gradients in CO mixing ratios were seen to develop over a period of several days. Over the Arabian Sea, mixing ratios of the order of 150 parts per billion by volume were observed before the monsoon onset, and a pronounced decrease in CO was detected toward the equator. Subsequent measurements after the monsoon had become established revealed a consistent decrease in CO mixing ratio across this region. Analysis of aircraft dropsonde data and constant pressure daily streamline charts across this region. Analysis of aircraft dropsonde data and constant pressure daily streamline charts lend strong support to the hypothesis that this reduction is associated with influx of CO-poor southern hemisphere air in the monsoon southwesterlies. (Author's abstract) W87-04683

GAS FILTER RADIOMETER FOR CARBON MONOXIDE MEASUREMENTS DURING THE 1979 SUMMER MONSOON EXPERIMENT

National Aeronautics and Space Administration, Hampton, VA. Langley Research Center.

For primary bibliographic entry see Field 5A. W87-04684

SPECIATION, PHOTOSENSITIVITY, AND REACTIONS OF TRANSITION METAL IONS IN ATMOSPHERIC DROPLETS, Bell Communications Research, Inc., Holmdel, NJ. C. J. Weschler, M. L. Mandich, and T. E. Graedel. Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 4, p 5189-5204, April 20, 1986. 1 fig, 7 tab, 155 ref, append.

Descriptors: "Water pollution sources, "Speciation, "Photosensitivity, "Chemical reactions, "Transition metal ions, "Ions, "Atmospheric droplets, Equilibrium, Metals, Chemical complexes, Iron, Manganese, Copper, Nickel.

Dissolved transition metal ions (TMI) are common constituents of atmospheric droplets. They are known to catalyze sulfur oxidation in droplets and constituents of atmospheric droplets. They are known to catalyze sulfur oxidation in droplets and are suspected of being involved in other chemical processes as well. The relevant equilibrium constants and chemical reactions of the major TMI (iron, maganese, copper, and nickel), their ability to form complexes in aqueous solution, and their potential involvemen: in photochemical processes in atmospheric droplets were reviewed. Among the results are the following: (1) The major Fe(III) species in atmospheric water droplets are Fe(OH)(H2O)5(2+), Fe(OH)2(H2O)4(+), and Fe(SO3)(H2O)5(2+), Fe(OH)2(H2O)4(+), and Fe(SO3)(H2O)5(+); the partitioning among these complexes is a function of pH. In contrast, Cu(II), Mn(II), and Ni(II) exist almost entirely in the droplets as hexaquo complexes. (2) Within the tropospheric solar spectrum, some of the complexes of Fe(III) have large absorption cross sections. Cross-section data for several of the complexes were reported. Absorption of solar photons by such complexes is generally followed by cleavage, which in the same process reduces the iron(III) atom and produces a reactive free radical. This mechanism has the potential to be a significant and heretofore unappreciated source of free radicals in atmospheric droplets. (3) TMI participate in redox reactions with H2O2 and its associated species HO2(.) and O2(-). These reactions furnish the potential for catalytic cycles involving TMI in atmospheric droplets under a variety of illumination and acidity conditions. (4) A number of organic processes in atmospheric droplets to stable alcohols and acids, and the oxidation of aliphatic aldehydes to organic acids. (Author's abstract) W87-04686

OPTIMIZED RETRIEVALS OF PRECIPITA-BLE WATER FIELDS FROM COMBINATIONS OF VAS SATELLITE AND CONVENTIONAL SURFACE OBSERVATIONS, National Aeromatics and Space Administration

National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center. W. D. Robinson, D. Chesters, and L. W. Uccellini. Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 4, p 5305-5318, April 20, 1986. 7 fig, 1 tab. 14 ref. 2 append tab, 14 ref, 2 append.

Descriptors: "Spectral analysis, "Remote sensing, "Precipitable water, "Data acquisition, "Data storage and retrieval, "VAS satellites, "Satellite technology, Surface temperature, Temperature, Dewpoint, Regression analysis, Atmosphere, Radiosondes.

VISSR (visible and infrared spin-scan radiometer) atmospheric sounder (VAS) radiances and conventional surface temperature and devopoint data are used in several combinations within a regression approach to determine the optimum resolution and accuracy of precipitable water (PW) fields retrieved from satellite observations. Point retrievals trieved from satellife observations. Point retrievals at radiosonde stations are used to determine the numerical accuracy of each retrieval technique, and image sequences of the retrieved PW fields are used to determine the temporal stability and spatial coherence of mesoscale PW features. VAS channels 5, 6, 7, and 8 (at 13, 4.5, 12, and 11 micron) and the surface dewpoint contribute the most information to regression-based retrievals of PW.

The most accurate PW retrievals are obtained when radiances are averaged to a resolution of 15 Ine most accurate PW retrievals are obtained when radiances are averaged to a resolution of 15 to 60 km. A physical split-window approach provides better PW estimates than regression when only the 11- and 12-micron VAS channels are available (as when the satellite operates in a multispectral image mode) or when radiosonde-based training is limited to only one time period. (Author's abstract) W87-04687

ATMOSPHERIC DEPOSITION IN FENNO-SCANDIA: CHARACTERISTICS AND TRENDS, Norsk Inst. for Luftforskning, Kjeller. For primary bibliographic entry see Field 5B. W87-04694

ACIDIC DEPOSITION AND ITS EFFECTS ON THE FORESTS OF NORDIC EUROPE, Sveriges Lantbruksuniversitet, Uppsala. Inst. foer Ekologi och Miljoevaard. For primary bibliographic entry see Field 5C. W87-04695

PROJECT RAIN: CHANGING ACID DEPOSI-TION TO WHOLE CATCHMENTS, THE FIRST YEAR OF TREATMENT, Norsk Inst. for Vannforskning, Oslo.

Norsk fist. 107 vannforskings, Casc. R. F. Wright, E. Gjessing, N. Christophersen, E. Lotse, and H. M. Seip. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 47-63, September 1986. 4 fig, 3 tab, 12

Descriptors: *Project Rain, *Acid rain, *Water pollution effects, *Soil chemistry, *Precipitation, *Acidification, Runoff, Snowmelt, Catchment areas, Norway, Deposition.

Vigorous efforts to obtain reductions in the emissions of acidifying compounds SO2 and NOx to the atmosphere are in part based on the premise that such reductions will restore acidified waters. The magnitude and rate of response of natural ecosystems to changes in acid loading is, however, not well known, largely because such effects have been difficult to document in the absence of large-scale reductions. Projects Rain (Reversing Acidification In Norway) is a 5-yr international research project aimed at investigating the effect on water and soil chemistry of changing acid deposition to whole catchments. The project comprises 2 parallel large-scale experimental manipulations – artificial acidification at Sogndal and exclusion of acid rain at Risdalsheia. Treatment at Sogndal commenced April 1984 with the acidification of the snowpack by addition of H2SO4 (SOG2) and a 1:1 mixture of H2SO4 and HNO3 (SOG4). Preliminary results indicate rapid and significant response in runoff chemistry to the acid treatment; pH decreased (to as low as 4.1 during snowmelt in 1984); SO4, NO3, and labile Al increased. Response during snowmelt 1985 was modest relative to 1984. At Risdalsheia treatment began in June 1984 with the mounting of the transparent panels on the roofs at KIM catchment (treatment by deacidified rain) and EGIL catchment (control with ambient acid rain). Preliminary data for the first year indicate that most runoff samples from KIM contain much lower NO3 concentrations, about 20 to 30% lower SO4 levels and pH O.1 to 0.3 units higher than runoff from EGIL catchment. The treatments continue in 1984-87. Project RAIN provides experimental evidence bearing on target loading, reversmental evidence bearing on target loading, reversments. runoit from EGIL catchment. In the treatments continue in 1985-87. Project RAIN provides experimental evidence bearing on target loading, reversibility of acidification, and the processes linking acid deposition, soil acidification and freshwater acidification. (Alexander-PTT)

ACID DEPOSITION AND EFFECTS IN NORDIC EUROPE, DAMAGE TO FISH POPU-LATIONS IN SCANDINAVIA CONTINUE TO APACE,

AFACE, Direktoratet for Vilt og Ferskvannsfisk, Trond-heim (Norway). Fish Research Div. For primary bibliographic entry see Field 5C. W87-04698

Group 2B—Precipitation

MEASURING DRY DEPOSITION: A RE-AS-SESSMENT OF THE STATE OF THE ART, National Oceanic and Atmospheric Administra-tion, Oak Ridge, TN. Air Resources Atmospheric Turbulence and Diffusion Lab. For primary bibliographic entry see Field 5A.

POLLUTANT WET DEPOSITION MECHANISMS IN PRECIPITATION AND FOG WATER,

Atmospheric Environment Service, Downsview (Ontario). For primary bibliographic entry see Field 5B.

RAIN, SNOW AND LAKE WATER CHEMIS-TRY ON AND NEAR THE PRECAMBRIAN SHIELD OF WESTERN CANADA,

Saskatchewan Research Council, Saskatoon. S. R. Shewchuk

Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 115-123, September 1986. 1 fig, 5 tab, 19

Descriptors: *Water pollution sources, *Rainfall, *Lakes, *Snow, *Water analysis, *Surveys, *Acid rain, Deposition, Sulfur emissions, Canada, Sulfates, Metals, Precambrian Shield.

At several locations in western Canada the Pre-cambrian Shield is sensitive to acidic deposition. There are significant point source emitters of SOx and NOx within and near this area. An emissions and NOx within and near this area. An emissions inventory for these sources is given in Still Waters. Regional surveys of rain, snow and lake water chemistry have been conducted in several locations of western Canada which are considered sensitive to acidic deposition and are within several hundred kilometers of major Canadian point source emitters (664,000 ton SO2 in 1981). Snow source emitters (664,000 ton SO2 in 1981). Snow and rain in the western Precambrian Shield is acidic with pH values generally ranging between 5.0 and 6.4. However, there is little evidence to suggest that the area is receiving significant amounts of acidic deposition. Total deposition of sulfate is approximately 2 kg/ha between the months of April to October in 1983. Environmental impacts at present are minimal with most small tal impacts at present are minimal with most small lakes in the region having pH values near neutrali-ty and low concentrations of metals such as Al. (Alexander-PTT) W87-04702

ACIDIC PRECIPITATION IN WESTERN NORTH AMERICA: TRENDS, SOURCES, AND ALTITUDE EFFECTS IN NEW MEXICO 1979-1985

New Mexico Inst. of Mining and Technology, Socorro. For primary bibliographic entry see Field 5B.

W87-04703

PATTERNS OF ACID DEPOSITION TO A DANISH SPRUCE FOREST, Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology. For primary bibliographic entry see Field 5B. W87-04704

CHEMICAL COMPOSITION OF PRECIPITA-TION AT LONG ISLAND, NY, Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment. For primary bibliographic entry see Field 5A W87-04705

COMPARISON OF SUMMER AND WINTER MEASUREMENTS OF ATMOSPHERIC NI-TROGEN AND SULPHUR COMPOUNDS, Atmospheric Environment Service, Downsview (Ontario). For primary bibliographic entry see Field 5A. W87-04706

LICHEN SULPHUR AND LEAD LEVELS IN RELATION TO DEPOSITION PATTERNS IN EASTERN CANADA,

Atmospheric Environment Service, Downsview (Ontario). For primary bibliographic entry see Field 5B. W87-04707

DISTRIBUTION OF POLLUTANTS NEAR A FRONTAL SURFACE: A COMPARISON BE-TWEEN FIELD EXPERIMENT AND MODEL-

Atmospheric Environment Service, Downsview For primary bibliographic entry see Field 5B. W87-04708

MONTHLY MEAN SPATIAL VARIATIONS OF DRY DEPOSITION VELOCITIES OF OXIDES OF SULPHUR AND NITROGEN, Department of the Environment, Ottawa (Ontar-For primary bibliographic entry see Field 5B. W87-04709

EDDY CORRELATION MEASUREMENTS OF DRY DEPOSITION FLUXES USING A TUNA-BLE DIODE LASER ABSORPTION SPEC-TROMETER GAS MONITOR, Ontario Hydro Research Lab., Toronto. For primary bibliographic entry see Field 5A. W87-04710

EFFECT OF A STRATUS CLOUD ON THE RE-DISTRIBUTION AND TRANSFORMATION OF POLLUTANTS,

Toronto Univ. (Ontario). Dept. of Physics. For primary bibliographic entry see Field 5B. W87-04711

MODELING OF THROUGHFALL CHEMIS-

TRY AND INDIRECT MEASUREMENT OF DRY DEPOSITION,
Oklahoma State Univ., Stillwater. School of Chemical Engineering.
For primary bibliographic entry see Field 5B.
W87-04713

COMPOSITION OF PRECIPITATION AT SNO-QUALMIE PASS AND STEVENS PASS IN THE CENTRAL CASCADES OF WASHINGTON STATE, Central Washington Univ., Ellensburg. Dept. of

Chemistry. For primary bibliographic entry see Field 5A. W87-04714

PRECIPITATION CHEMISTRY MEASURE-MENT IN ALBERTA, Alberta Environmental Centre, Vegreville. For primary bibliographic entry see Field SA. W87-04715

RAINFALL ACIDITY IN NORTHERN BRIT-AIN - EXPLORING THE DATA, Institute of Terrestrial Ecology, Edinburgh (Scotland). For primary bibliographic entry see Field 5A. W87-04716

ROLE OF ALKALINE MATERIALS IN PRE-CIPITATION CHEMISTRY: A BRIEF REVIEW OF THE ISSUES,

Illinois State Water Survey Div., Champaign. For primary bibliographic entry see Field 5B. W87-04717

SPATIAL AND TEMPORAL PATTERN OF SULFATE AND NITRATE WET DEPOSITION

Ontario Ministry of the Environment, Tor For primary bibliographic entry see Field 5B.

SPATIAL AND TEMPORAL VARIATION OF THE SULPHATE TO NITRATE RATIO IN PRECIPITATION IN EASTERN NORTH

AMERICA,
Atmospheric Environment Service, Downsview (Ontario). For primary bibliographic entry see Field 5B. W87-04720

ALKALINE MATERIALS FLUX FROM UN-PAVED ROADS: SOURCE STRENGTH, CHEM-ISTRY AND POTENTIAL FOR ACID RAIN NEUTRALIZATION, Illinois State Water Survey Div., Champaign. For primary bibliographic entry see Field 5B. W87-04721

UNCERTAINTIES IN ESTIMATING AREAL MEANS: WITH APPLICATIONS TO NADP/NTN DATA, Illinois State Water Survey Div., Champaign. For primary bibliographic entry see Field 5B. W87-04722

WET AND DRY DEPOSITION OF SULPHATES AND NITRATES IN EASTERN CANADA: 1979-1982.

Atmospheric Environment Service, Downsview (Ontario). For primary bibliographic entry see Field 5B. W87-04723

OVERVIEW OF HISTORICAL AND PALEO-COLOGICAL STUDIES OF ACIDIC AIR POL-LUTION AND ITS EFFECTS, Maine Univ. at Orono. Dept. of Botany and Plant For primary bibliographic entry see Field 5B. W87-04724

BIOLOGY AND CHEMISTRY OF THREE PENNSYLVANIA LAKES: RESPONSES TO ACID PRECIPITATION, Lehigh Univ., Bethlehem, PA. Center for Marine and Environmental Studies. For primary bibliographic entry see Field 2H. W87-04741

MANGANESE BIOGEOCHEMISTRY IN A SMALL ADIRONDACK FORESTED LAKE WA-Geological Survey, Doraville, GA. Water Resources Div. TERSHED. For primary bibliographic entry see Field 5B. W87-04754

EFFECIS OF ACIDITY OF SIMULATED RAIN AND ITS INFLUENCE ON THE PHYTOTOXI-CITY OF CHLORSULFURON ON VELVET-LEAF AND BARLEY, Virginia Polytechnic Inst. and State Univ., Blacks-burg. Dept. of Plant Pathology and Physiology. For primary bibliographic entry see Field 5C. W87-04826

UNUSUAL CLOUDS OVER PERTH, WESTERN AUSTRALIA, AUSTRALIA, A. J. Prata, and L. Van Burgel. Weather WTHRAL, Vol. 41, No. 10, p 320-327, October 1986. 6 fig, 3 ref.

Descriptors: *Clouds, *Cloud physics, *Perth, Australia, *Synoptic analysis, *Weather patterns, Wind, Sea breezes, Thunderstorms.

Unusual cloud formations attributed to the colli-sion of a cold density current from a collapsing cumulonimbus cloud with a light southwesterly sea cumulonimbus cloud with a light southwesterly sea breeze were observed over Perth, Australia on January 31, 1985. Radar reports from the airport indicated strong echoes to the north and east, and thunderstorms to the north brought heavy rainfall and hail. A feature of the summer weather in the southwest corner of western Australia is the occur-rence of sea breezes in the afternoon. Their onset

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and strength depend on local conditions as well as and strength depend on local conditions as well as the general synoptic pattern. It is postulated that the sea breeze air was forced to ride on top of a cold outflowing current which would account for the flat bases of the clouds and their shallow vertical extent. The low level cold air flowing outwards from a thunderstorm is an example of a density current. The role of the overall synoptic situation may also have been important for the generation of this phenomenon. (Michael-PTT)

EFFECTS OF ENHANCED INITIAL MOISTURE FIELDS ON SIMULATED RAINFALL OVER WEST AFRICA AND THE EAST ATLAN-TIC,

Pennsylvania State Univ., University Park. Dept. of Meteorology.
N. T. Diallo, and W. M. Frank.
Monthly Weather Review MWREAB, Vol. 114,
No. 10, p 1811-1821, October 1986. 12 fig, 1 tab, 25 ref. NSF Grant ATM-8317013.

Descriptors: *Moisture fields, *Mathematical models, *Weather forecasting, *Remote sensing, *Rainfall, *Simulated rainfall, *Tropical rainfall, *Numerical simulations, *Simulation, Forecasting, West Africa, Atlantic Ocean, Satellite technology, Rawinsonde soundings, Numerical forecasts, Numerical simulations, Performance evaluation.

Numerical simulations of a 24-h period during GATE are performed to evaluate the impact of enhanced initial moisture fields on short range forecasts of tropical rainfall. The domain covers West Africa and most of the eastern half of the Atlantic Ocean. A version of the Pennsylvania State University Mesoscale Model is used, and results are verified against satellite rainfall estimates. The initial moisture fields are enhanced subjectively using visible satellite imagery, available rawinsonde soundings and monthly mean soundings. The rainfall forecasts with initial moistures enhanced throughout the analysis region clearly outperform forecasts which use either the unaltered initial moisture analysis or an analysis performed with selectively enhanced moisture soundings. The former produce better zonal and soundings. The former produce better zonal and meridional distributions of rain, narrower and meridional distributions of rain, narrower and more intense intertropical convergence zone re-gions and stronger local maxima in agreement with verification. The success of the relatively simple moisture enhancement used in this study suggest that satellite-enhanced moisture analysis will have a major impact on short-range numerical forecasts of tropical rainfall. (Author's abstract) W87-04973

SOME COMMENTS ON PASSIVE MICRO-WAVE MEASUREMENT OF RAIN, National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center. For primary bibliographic entry see Field 7B. W87-04975

EXAMINATION OF A SUBGRID-SCALE PARAMETERIZATION FOR THE TRANSPORT OF POLLUTANTS IN A NONPRECIPITATING CUMULUS CLOUD ENSEMBLE, Iowa Univ., Iowa City. Dept. of Chemical Materials Engineering. For primary bibliographic entry see Field 5B. W87-04992

REMOVAL OF SULPHUR DIOXIDE IN A TWO-DIMENSIONAL RAIN SYSTEM BASED ON A SCALE ANALYSIS OF THE CONSERVATION EQUATIONS, Central Electricity Generating Board, Leatherhead (England). Central Electricity Research

For primary bibliographic entry see Field 5B. W87-04993

2C. Snow, Ice, and Frost

RECORD ST. CLAIR RIVER ICE JAM OF 1984.

National Oceanic and Atmospheric Administra-tion, Ann Arbor, MI. Great Lakes Environmental Research Lab.

J. A. Derecki, and F. H. Quinn. Journal of Hydraulic Engineering JHEND8, Vol. 112, No. 12, p 1182-1194, December 1986. 10 fig, 4

Descriptors: *Ice jams, *St. Clair River, *Great Lakes, *Lake level, *Water level, *Water level fluctuations, Navigation, Lakes, Computer simula-

The record St. Clair River ice jam of April 1984 produced major impacts on the levels and flows of the Great Lakes, and on navigation throughout the system. Flows in the river were monitored by continuously recording electromagnetic current meters at a flow measuring station located in the upper river, near its head. The water levels of Lake St. Clair and of the St. Clair River were Lake St. Clair and of the St. Clair River were measured at a number of sites. Following the onset of the jam, Lake St. Clair water levels dropped about 0.6 m as the inflow was decreased by the jam. At the peak of the jam the flows were reduced by approximately 65%. The jam had a duration of 24 days. Following the jam breaking on April 29, 1984, the waters of Lake St. Clair rose regidly recovering amproximately 15% of the decreased of the statement of the statem April 29, 1984, the waters of Lake St. Clair rose rapidly, recovering approximately 75% of the drop in levels in four days. Computer simulations indicated that it will take about a year for most and at least 3 years for all excess water stored in Lakes Michigan and Huron during the jam to be dissipated and for levels in those lakes (and Lakes St. Clair and Erie, downstream) to return to prejam condi-tions. (Wood-PTT) W87-04392

NUTRIENT LIMITATION OF THE BOTTOM-ICE MICROALGAL BIOMASS (SOUTHEAST-ERN HUDSON BAY, CANADIAN ARCTIC),

Centre de Recherche en Ecologie Marine et Aqua-culture, Nieul sur Mer (France). S. Y. Maestrini, M. Rochet, L. Legendre, and S.

Limnology and Oceanography LIOCAH, Vol. 31, No. 5, p 969-982, September 1986. 8 fig, 4 tab, 55

Descriptors: *Limiting nutrients, *Anchor ice, *Algae, *Biomass, *Bioassay, *Ice-water interface, Incubation, Cultures, Microalgae, Inorganic nitrogen, Nutrients, Seasonal variation, Phytoplankton, Hydrodynamics, Light quality, Mixing, Hudson Bay, Yield, Growth.

In polar and subpolar seas, microalgae can be found in very high concentraions at the ice-water interface and in the lower part of the ice. These bottom-ice microalgae are either attached to ice crystals or suspended in the interstitial water of the sea ice and consist largely of benthic pennate diacons. In April 1983, differential-enrichment bioassays were conducted on natural sea-ice microalgae from Hudson Bay Candian Active Incubations. toms. In April 1983, differential-enrichment bloassays were conducted on natural sea-ice microalgae
from Hudson Bay, Canadian Arctic. Incubations
were done both in the laboratory (at about 4 - 5 C),
and in situ at the ice-water interface (-1.5 C).
Actual growth of the cultures was nutrient limited.
On the basis of observations and using recalculated
data from the literature, the authors tentatively set
the mean generation time of Arctic-ice microalgae
between 8 and 17 days. Nitrogen was demonstrated
to govern the algal yield when illumination and
grazing allowed the algae to grow. The low
(NO3C) + NO2C) + NH4(+):PO(4:3) mean
ratio (5.9) in the water at the ice interface leads to
the same conclusion. In situ dissolved inorganic
nitrogen and phosphorus progressively decreased
during the course of sampling, but were never
exhausted. It was hypothesized that the K sub S of
epontic as well as of other benthic microalgae is
higher than that of phytoplankton, so that they
cannot deplete the natural nutrient reservoir. It
was concluded that the bottom-loc dynamics is
controlled not only from above, by the seasonal was concluded that the bottom-ice dynamics is controlled not only from above, by the seasonal (climatic) changes in light intensity as generally assumed, but also from below, by the shorter term (hydrodynamic) events of vertical mixing that re-plenish the ice-water interface with nutrients. (Al-

EFFECT OF SHORT-TERM ACIDIFICATION DURING SPRING SNOWMELT ON SELECT-ED MOLLUSCA IN SOUTH-CENTRAL ON-

TARIO, Guelph Univ. (Ontario). Dept. of Zoology. For primary bibliographic entry see Field 5C. W87-04454

EFFECTS OF TEMPERATURE ON 86RB UPTAKE BY TWO SPECIES OF CHLAMYDO-MONAS (CHLOROPHYTA, CHLOROPHY-CEAE),

British Antarctic Survey, Cambridge (England). A. Clarke, E. A. Leeson, and G. J. Morris. Journal of Experimental Botany JEBIAM, Vol. 37, No. 182, p 1285-1293, September 1986. 3 fig. 1 tab,

Descriptors: *Isotope studies, *Bioaccumulation, *Algae, *Temperature effects, *Chlorophyta, Cell membranes, Scintillation counters, Snow, Acclimatization, Rubidium-86.

86Rb uptake was examined in two species of uni-cellular green algae, Chlamydomonas nivalis isolat-ed from snow, and a cell wall-less mutant of the temperate freshwater Chlamydomonas reinhardii. After cell incubation with 86Rb, cells were centri-fuged and resuspended in fresh medium without the isotope. No 86Rb was detectable in the super-natant following three washes. The cells were then lysed and the supernatant counted for 86Rb by Cerenkov emission in the 3H channel of a scintilla-tion counter. Uptake rates were calculated only for the initial period of 86Rb accumulation and all data were corrected for isotope decay to 09.00 of the the initial period of 86Rb accumulation and all data were corrected for isotope decay to 09.00 of the day of the experiment. In C. reinhardii cells grown at 20 C and cooled rapidly to 0 C, 86Rb uptake was abolished. Cells cooled rapidly to -5 C in the absence of ice accumulated 86Rb rapidly. Cells grown at 8 C were viable, able to divide and motile; they showed no sign of cold-shock and 86Rb uptake, was measurable at -5 C in the absence of extracellular ice. Cells of C. nivalis grown at 20 C were demanded as sub-recontemporaries. sence of extracellular ice. Cells of C. nivalis grown at 20 C were damaged at sub-zero temperatures although they did show an enhanced 86Rb uptake at 0 C. Cells grown at 5 C were able to accumulate 86Rb from media undercooled to -5 C in the absence of extracellular ice, and again showed enhanced uptake at 0 C. The process of acclimation to low temperature appears to differ in the two species. (Main-PTT) W87-04541

GLACIER VARIATIONS AND THEIR CAUSES IN THE NORTHERN PATAGONIA ICEFIELD,

Crille, SINCE 1944, Tsukuba Univ. (Japan). Inst. of Geoscience. M. Aniya, and H. Enomoto. Arctic and Alpine Research, ATLPAV, Vol. 18, No. 3, p 307-316, August 1986. 8 fig, 2 tab, 36 ref. Japanese Ministry of Education, Science and Cul-ture Projects 58041045 and 59043040.

Descriptors: *Climates, *Glaciers, *Glacial recession, *Patagonia icefield, *Chile, Ice spilling, Aerial photography, Glacial calves, Temperature, Precipitation, Snow, Outlet glaciers, Weather data collections.

The variations of six outlet glaciers of the northern The variations of six dutiet ginacters of the northern Patagonia icefield were investigated. Aerial photographs taken in 1944/45, 1974/75, and 1983/84 were compared with the climatic trend. Between 1944 and 1984, a maximum recession of around 2.5 1944 and 1984, a maximum recession of around 2.5 km was observed at two calving glaciers, while no variation occurred at one glacier. Three patterns of variations were recognized: fairly constant recession during the last 40 yr (two glaciers); rapid retreat during the 1974-1984 period (two glaciers); and rapid retreat between 1944 and 1958. The amount of the surface lowering ranged from 40 to 120 m during the last 40 yr. These retreat and surface lowering rates were comparable to those reported for glaciers in other regions. The temperature and precipitation data recorded at a nearby station did not show any definite trends which ature and precipitation data recorded at a nearby station did not show any definite trends which could explain the glacier variations. This suggests strong local variation of the snow accumulation and effect of the relative height of the rock thresh-old on ice spilling. (Author's abstract)

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W87J04552

DISPERSION IN ICE-COVERED LAKES, Uppsala Univ. (Sweden). Dept. of Hydrology. For primary bibliographic entry see Field 2H. W87-0454

ATTEMPTING FLOW FORECASTS OF THE INDUS RIVER, PAKISTAN, USING REMOTE-LY SENSED SNOW COVER DATA, Waterloo Univ. (Ontario). For primary bibliographic entry see Field 2E. W87-04555

ESTIMATES OF NITRATE FORMATION IN RAIN AND SNOW SYSTEMS, Ford Motor Co., Dearborn, MI. For primary bibliographic entry see Field 5B. W87-04675

CHANGES IN PRECIPITATION CHEMISTRY AT DYE 3, GREENLAND, State Univ. of New York at Buffalo. Ice Core Lab. For primary bibliographic entry see Field 5B. W87-04685

RAIN, SNOW AND LAKE WATER CHEMISTRY ON AND NEAR THE PRECAMBRIAN SHIELD OF WESTERN CANADA, Saskatchewan Research Council, Saskatoon. For primary bibliographic entry see Field 2B. W87-04702

SNOW CHEMISTRY IN THE FLIN FLON AREA OF MANITOBA, 1981-1984, Manitoba Dept. of Environmental Management, Winnipeg. For primary bibliographic entry see Field 5B. W87-04718

DISSOLVED-OXYGEN DEPRESSION UNDER ICE COVER IN TWO YUKON RIVERS, Inland Waters Directorate, Vancouver (British Columbia). Pacific and Yukon Region. P. H. Whitfield, and B. McNaughton. Water Resources Research WRERAQ, Vol. 22, No. 12, p 1675-1679, November 1986. 5 fig, 19 ref.

Descriptors: *Dissolved oxygen, *Ice cover, *Rivers, *Seasonal variation, *Organic carbon, Yukon, Canada, Nordenskiold River, Takahini River, Oxygen sag, Winter, Ice breakup.

Concentrations of dissolved oxygen under winter ice cover were studied during the winter of 1982-1983 in two Yukon (Canada) rivers, the Nordenshold and the Takahini. Oxygen in both rivers became depleted during the winter. The depletion of oxygen was more severe in the Nordenskiold, which had higher organic carbon concentrations. The development and progression of the depressions in oxygen content appear to be related to physical processes as well as biological consumption. About 80% of the depression takes place during the formation of the ice cover. The results agree with earlier reports of depressions of dissolved oxygen under ice. The depression of oxygen observed during the formation of ice was much more rapid than had been described previously. The level of dissolved oxygen in these rivers returned to the saturation concentration before the ice cover broke up. (Author's abstract)

SNOW DISTRIBUTION PATTERNS IN CLEARINGS AND ADJACENT FOREST, British Columbia Univ., Vancouver. Faculty of Forestry.
D. L. Golding, and R. H. Swanson.
Water Resources Research WRERAQ, Vol. 22, No. 13, p 1931-1940, December 1986. 7 fig, 6 tab, 23 ref. NSERC (Canada) Grant A6957.

Descriptors: *Snow distribution, *Forests, *Clearings, *Snow accumulation, *Ablation, *Water-

sheds, *Snowmelt, *Snowpack, Temporal variation, Spatial variation, Hydrologic budget.

The interaction of snow accumulation and ablation with forest and forest clearings is important in any hydrologic system in which snowmelt accounts for a substantial part of streamflow. Water yield increases of less than 20 mm to more than 140 mm have resulted from partial or complete forest cutting in the Rocky Mountain region of the United States and Canada. These increases are due to changes in evapotranspiration and in patterns of snow accumulation and ablation. Snow accumulation patterns were determined for clearings and adjacent forest at Marmot Creek experimental watershed and James River, Alberta. At maximum accumulation snow water equivalent (SWE) was greater in clearings than in the forest whether clearings were large, as in 8- to 13-ha blocks where SWE averaged 20% more than in the forest, or small as in the 1/4 to 6-H (height) diameter circular clearings where SWE was 13-45% greater than in the forest. SWE was 42 to 52% less in north than in south sectors of 2-6 H clearings. These differences increased with clearing size and time since beginning of accumulation period and are caused by snow ablation (melt and evaporation), a function of direct solar radiation reaching the snowpack. In such situations the snow that has accumulated on the ground cannot be considered a measure of the snow that has actually fallen there. For water balances and hydrologic modelling, snow measurements in partially cleared watersheds must be adjusted for temporal and spatial factors specific to the watershed. (Alexander-PTT)

SYNOPTIC-SCALE INFLUENCES OF SNOW COVER AND SEA ICE, Illinois Univ. at Urbana-Champaign. Dept. of Atmospheric Sciences. B. Ross, and J. E. Walsh.

Monthly Weather Review MWREAB, Vol. 114, No. 10, p 1795-1810, October 1986. 14 fig, 27 ref, append. NSF Grant ATM-8507782.

Descriptors: *Snow, *Snow cover, *Storm intensity, *Ice, *Sea ice, *Synoptic analysis, *Cyclones, *Cyclone intensification, *Weather forecasting, *Mathematical models, Storms, Cyclone trajectories, North America, North Atlantic Ocean, North Pacific Ocean, Barotropic models, Forecasting, Mathematical equations, Weather data collections.

Daily observational data for thirty winters (1951-80) are used to test the hypothesis that anomalous distributions of snow and ice cover influence the intensification and/or trajectories of synoptic-scale cyclones. The pools of objectively chosen cases include 100 wintertime cyclonic events in the marginal snow/ice zones of each of three regions: eastern North America, the North Atlantic Ocean and the North Pacific Ocean. For each region, the errors of 24- and 48-hour forecasts derived from a barotropic model, from persistence and from an objective analog procedure are straified according to the concurrent anomalies of snow or ice cover. The results support the notion that the enhanced baroclinicity near the snow/ice margin contributes to stronger intensification and/or to motion parallel to the snow or ice margin in eastern North America and in the North Atlantic. A weaker signal is found in the North Pacific. The signal is qualitatively similar in the fields of 500 mb geopotential and sea level pressure, although the differences between the composites are statistically significant only in the sea level pressure fields. The results suggest that forecasts of weekly or monthly circulation patterns may, in situations of extreme snow/ice cover, be improved by consideration of observed snow/ice anomalies, if these anomalies persist through the forecast period. Controlled experiments with the National Center for Atmospheric Research primitive equations forecast model show a weaker dependence on the extent of snow and ice, although qualitative similarities to the data-based results are detectable. (Author's abstract)

FRONTOGENESIS AND SYMMETRIC STA-BILITY IN A MAJOR NEW ENGLAND SNOW-STORM,

F. Sanders. Monthly Weather Review MWREAB, Vol. 114, No. 10, p 1847-1862, October 1986. 13 fig, 3 tab, 27 ref. NSF Grant ATM-8407142.

Descriptors: *Snow, *Remote sensing, *Snow-storms, *Stability analysis, *Frontogenesis, *Radar, *Cyclones, *Storms, New England, Weather, Mathematical equations.

Synoptic and Doppler radar are used to study the roles of large-scale frontogenetical forcing and of moist symmetric instability in the New England snowstorm of 5-6 December 1981, associated with an explosively intensifying cyclone offshore. Radar reflectivity patterns showed a tendency toward banded structure, particularly near the leading (northwestern) edge of the storm. Only a minor portion of the snowfall, however, was associated with this pronounced bandedness. From a set of constant-pressure analyses, the frontogenetical forcing was measured from the variation along the temperature gradient of the geostrophic wind component in the direction of this gradient. Over southeastern New England maximum forcing, found near 500 mb at the outset of the storm, descended to the layer between 850 and 700 mb 24 h later. Doppler radar observations showed strong convergence just above the zone of maximum frontogenesis and at the base of a region of vigorous ascent, with a magnitude of a few tens of cm/s. Symmetric stability was evaluated, for a geostrophic base-state flow, from a series of vertical cross sections as close as possible to the radar site. Only a small area of instability appeared in the saturated middle and upper troposphere near the outset of the storm. The small instability accompanying the frontogenetical forcing was consistent with recent analytic and numerical models showing a vigorous and concentrated updraft. (Author's abstract)

2D. Evaporation and Transpiration

COMPARING SPRINKLER IRRIGATION AND FLOOD IRRIGATION FOR RICE, Louisiana Agricultural Experiment Station, St. Joseph. Northeast Research Station. For primary bibliographic entry see Field 3F. W87-04368

PHOTOSYNTHESIS AND GROWTH OF WATER HYACINTH UNDER CO2 ENRICH-MENT, Florida Univ., Gainesville. Dept. of Botany. W. Spencer, and G. Bowes.
Plant Physiology PLPHAY, Vol 82, No. 2, p 528-533, October 1986. 4 fig. 7 tab, 33 ref. USDA Grant 82-CRCR-1-1147.

Descriptors: *Water hyacinth, *Carbon dioxide enrichments, *Photosynthesis, *Plant growth, Growth chambers, Leaves, Transpiration, Leaf resistance, Tissue analysis, Photorespiration, Dark respiration.

Water hyacinth (Eichhornia crassipes (Mart.) Solms) plants were grown in environmental chambers of ambient and enriched CO2 levels (330 and 600 microliter CO2/I). Daughter plants (ramets) produced in the enriched CO2 gained 39% greater dry weight than those at ambient CO2, but the original mother plants did not. The CO2 enrichment increased the number of leaves per ramet and leaf area index, but did not significantly increase leaf size or the number or ramets formed. Flower production was increased 147%. The elevated CO2 increased the net photosynthetic rate of the mother plants by 40%, but this was not maintained as the plants acclimated to the higher CO2 level. Effects of CO2 enrichment on photosynthetic rate, leaf resistance, transpiration, tissue constituents, and photorespiration and dark respiration were examined. It appears that with CO2 enrichment the temporary increase in net photosynthesis produced larger ramets. After acclimation, the greater total ramet area more than compensated for the lower

net photosynthetic rate on a unit leaf area basis and resulted in a sustained improvement in dry weight gain. (Rochester-PTT) W87-04376

EFFECT OF FOLIAR APPLICATION OF FULVIC ACID ON WATER USE, NUTRIENT UPTAKE AND YIELD IN WHEAT,

Henan Research Inst. of Biology, Zhen-ZZhou (Chins).

X. Xudan.

Australian Journal of Agricultural Research AJAEA9, Vol. 37, No. 4, p 343-350, 1986. 4 fig, 6 tab, 16 ref.

Descriptors: *Grain crops, *Fulvic acids, *Water stress, *Plant growth, *Wheat, *Water use, *Nutrient uptake, *Crop yield, *Stomata, Chlorophyll, North China, Field tests, Drought, Winds.

The effect of foliar applications of fulvic acid (FA) on water use, nutrient uptake, and yield was stud-ied in pot experiments and field trials. FA reduced the stomatal conductance of well-watered plants in neu in por experiments and field trials. FA reduced the stomatal conductance of well-watered plants in pots from about 0.80 to about 0.25 cm/sec. The stomatal conductance of control plants fell continuously from about 0.85 cm/sec to almost 0.00 over a 9-day drying cycle. Plants sprayed with FA at the beginning of the cycle maintained a stomatal conductance of about 0.30 cm/sec for the whole period. Spraying with FA resulted in a higher level of chlorophyll in the leaves and a greater rate of P-32 uptake by the roots. When droughted at eardevelopment stage, grain yield was depressed by 30%. Spraying with FA increased the yield of droughted plants to 97% of the irrigated controls. Field trials in North China demonstrated that when FA was used to decrease the water stress or stress imposed by hot, dry winds during ear development, grain yield increased by 7.3-18.0%. (Author's abstract) W87_04381

EFFECT OF SIMULATED WET SPRING CON-DITIONS ON THE RELATIVE EFFICIENCY OF THREE FORMS OF NITROGEN FERTIL-IZER ON GRASSLAND,

Agriculture and Food Science Centre, Belfast (Northern Ireland). Agricultural and Food Chem-

istry Research Div.

C. J. Watson, and S. N. Adams.

The Journal of Agricultural Science, JASIAB,
Vol. 107, Part 1, p 219-222, August 1986. 3 tab, 10

Descriptors: *Simulated rainfall, *Climatic condi-tions, *Northern Ireland, *Ryegrass, *Nitrogen fertilizers, *Irrigation effects, Grasaland, Urea, Crop yield, Nitrification, Climate.

A field trial at Hillsborough (Northern Ireland) tested the effects of (NH4)2SO4, SCa(NO3)2.NH4NO3.10H20, or urea on an established sward of Italian ryegrass cv. RVP. Natural rainfall of 192 mm from February to April 1984 was supplemented with 92 mm of irrigation to create very wet spring conditions. At first cut, when no N irrigation had been applied, there was little difference between N forms in either yield or N uptake. In the presence of irrigation, however, nitrate-N resulted in significantly lower dry matter yield and N uptake compared with ammonium sulfate-N or urea-N. At the second cut there was no significant difference between the effects of the form of N or watering regime on dry matter yield or N uptake. This may reflect the increased plant demand for N at this stage and the higher rates of nitrification that may occur. (Rochester-PTT) A field trial at Hillsborough (Northern Irela

ROOT REGULATED WATER RELATION-SHIPS AND GROWTH OF GROUNDNUT

Andhra Pradesh Agricultural Univ., Hyderabad

For primar W87-04386 ary bibliographic entry see Field 2I. PHOTOSYNTHESIS AT LOW WATER POTEN-TIALS IN SUNFLOWER: LACK OF PHOTOIN-HIBITORY EFFECTS,

Illinois Univ. at Urbana-Champaign. Dept. of Plant Pathology.

Patnology. R. E. Sharp, and J. S. Boyer. Plant Physiology PLPHAY, Vol. 82, No. 1, p 90-95, September 1986. 5 fig, 1 tab, 34 ref. NSF Grant 95, September PCM 79-0979.

Descriptors: "Photosynthesis, "Water potentials "Sunflower, "Leaves, "Evapotranspiration "Water use, "Plant physiology, "Photoinhibition "Carbon dioxide, Dehydration, Oxygen, Respiration, Available water, Stomata.

tion, Available water, Stomata.

The losses in chloroplast capacity to fix CO2 when photosynthesis is reduced at low leaf water potential (psi sub I) have been proposed to result from photoinhibition. This possibility was investigated in soil-grown sunflower using gas exchange techniques to measure the influence of light during dehydration on in situ chloroplast capacity to fix CO2. The quantum yield for CO2 fixation as well as the rate of light- and CO2-saturated photosynthesis were strongly inhibited at low psi sub I. The extent of inhibition was the same whether the leaves were exposed to high or to low light during dehydration. The inhibition of the quantum yield was also unaffected when intercellular partial pressures of CO2 were decreased to the compensation point, which was lower than the partial pressures susteng from stomatal closure. Photoinhibition occurred only after high light exposures were imposed under nonphysiological low CO2 and C2 where both photosynthesis and photorespiration were suppressed. The experiments show that the loss in chloroplast capacity to fix CO2 was entirely the result of a direct effect of water availability on chloroplast function, and not photoinhibition. (Author's abstract)

WATER USE EFFICIENCIES IN RELATION TO SUGARCANE YIELDS, Booker Agricultural International Ltd., London (England).

R. A. Yates, and R. D. Taylor. Soil Use and Management, Vol. 2, No. 2, p 70-76, June 1986. 4 fig. 4 tab, 34 ref.

Descriptors: *Water use efficiency, *Sugarcane, *Evapotranspiration, *Irrigation effects, *Crop yield, Kenya, Soil types, Growth rates, Data anal-

The literature indicated that cane yield (tons cane per hectare (tc/ha)) was directly related to actual evapotranspiration (E sub t) and that a ratio 1 tc/ha/cm E sub t was a reasonable objective; this was frequently not attained in commercial practice. Analysis of extensive data from non-irrigated cane in upland Kenya demonstrated water use efficiencies of 0.5 to 0.6 tc/ha/cm E sub t in relationships which water represends the receives of the reasonable of cies of 0.5 to 0.0 to 2.7 as/cm is sub t in relationships which were remarkably precise. Some of the reasons for the failure to achieve higher efficiencies at this location were discussed. The practice of irrigation is likely to introduce additional complications and so reduce water efficiency even further; thus, responses to irrigation should be measured experienced. and 30 reduce was a contraction should be measured experimentally before capital expenditure is approved. The main additional complications were the interactions between irrigation and soil type on rooting and growth, in particular the influence of soil type on yield responses, and the fact that advective energy interfered with the convenient, direct relationships between radiation and evaporation and yield. (Author's abstract) W87-04576

PHOTOSYNTHETIC ACCLIMATION AND WATER-USE EFFICIENCY OF THREE SPECIES OF UNDERSTORY HERBACEOUS BAMBOO (GRAMINEAE) IN PANAMA, Pennsylvania Univ., Philadelphia. Dept. of Biol-

ogy. S. S. Mulkey. Oecologia OECOBX, Vol. 70, No. 4, p 514-519, November 1986. 1 fig, 2 tab, 40 ref. NSF Grant DEB83-04261.

Descriptors: *Photosynthesis, *Acclimitization, *Water use efficiency, *Species diversity, *Bamboo, Light quality, Production, Plant growth, Isotope studies, Herbs, Barro Colorado Island, Panama, Leaves, Irradiance, Canopy.

Treefalls in tropical forest produce areas of higher light, higher temperature, and lower humidity compared to shaded understory. The importance of this form of disturbance for the maintenance of of this form of disturbance for the maintenance of tropical tree species diversity has been established, but few studies have addressed the effects of large changes in these environmental parameters on the growth and reproduction of tropical understory species. To assess the role of photosynthetic acclimation in the response of tropical understory herbs to treefall light gaps, photosynthetic response curves were determined for three species of herbscuous bamboo growing in treatments of sun and shade at Barro Colorado Island, Panama. Increased maximum photosynthetic capacity did not always accompany higher ramet production in the sun treatment. Pharus latifolius reproduced abundantly in both treatments, and produced more ramets and accompany higher ramet production in the sun treatment. Pharus latifolius reproduced abundantly in both treatments, and produced more ramets and developed higher maximum photosynthetic capacity under higher irradiance. Streptochacta spicata also produced a high percentage of reproductive ramets in both treatments and produced more ramets in the sun, but did not show any significant differences in photosynthetic parameters between treatments. Streptochacta sodiroans adid not change maximum photosynthetic capacity in the sun, and had higher photosynthetic capacity in the sun, and had higher photosynthetic efficiency and lower mortality in the shade. Stable carbon isotope composition of leaves indicated that all three species developed higher water-use efficiency under higher irradiance. Photosynthetic flexibility may contribute to the ability of P. latifolius to reproduce in treefall gaps, whereas S. spicata and S. sodiroana may maintain the ability to fix carbon efficiently in low irradiance even when growing or persisting in gaps. (Alexander-PTT)

TISSUE WATER RELATIONS OF FOUR CO-OCCURRING CHAPARRAL SHRUBS, Stanford Univ., CA. Dept. of Biological Sciences. For primary bibliographic entry see Field 2I. W87-04652

BIOMASS ACCUMULATION AND RESOURCE UTILIZATION IN CO-OCCURRING GRASS-LAND ANNUALS, Stanford Univ., CA. Dept. of Biological Sciences. H. A. Mooney, R. J. Hobbs, J. Gorham, and K. Williams.

Oecologia OECOBX, Vol. 70, No. 4, p 555-558, November 1986. 5 fig, 1 tab, 9 ref. NSF Grant BSR 83-15675.

Descriptors: *Biomass, *Accumulation, *Water use, *Plant growth, *Annuals, Climates, Soil types, Reproduction, Soil moisture, Nutrients, California,

Mediterranean-climate annuals growing on serpen-tine soils in central California differ greatly in their life spans and reproductive periods dependent on their access to soil moisture. The longer-lived annuals accumulate a greater lifetime biomass, have a higher total, but lower proportional, reproductive output, and produce leaves with a higher C/N ratios at the time of reproduction. (Author's abstract) W87-04653

EVENT-BASED SIMULATION MODEL OF MOISTURE AND ENERGY FLUXES AT A BARE SOIL SURFACE, Princeton Univ., NJ. Dept. of Civil and Geological Engineering. For primary bibliographic entry see Field 2G. W87-04758

FOLIAGE TEMPERATURE: EFFECTS OF EN-VIRONMENTAL FACTORS WITH IMPLICA-TIONS FOR PLANT WATER STRESS ASSESS-MENT AND THE CO2/CLIMATE CONNEC-TION,

Group 2D—Evaporation and Transpiration

Agricultural Research Service, Phoenix, AZ. Water Conservation Lab. S. B. 10so, K. L. Clawson, and M. G. Anderson. Water Resources Research WRERAQ, Vol. 22, No. 12, p 1702-1716, November 1986. 10 fig, 150

Descriptors: *Temperature effects, *Air pollution effects, *Plant water potential, *Transpiration, *Water stress, *Carbon dioxide, *Climates, Diffusion resistance, Water hyacinth, Cotton, Alfalfa, Phoenix, Arizona, Vapor pressure, Radiation, Idso-Jackson plant water stress index, Antitranspirants.

In summer of 1985, several day-long sets of foliage temperature measurements were obtained for healthy and potentially transpiring water hyacinth, cotton, and alfalfa plants growing in a sealed and unventilated greenhouse at Phoenix, Arizona, along with concurrent measurements of air temperature, vapor pressure, and net radiation, plus, in the case of water hyacinth, leaf diffusion resistance measurements. Some data for these plants were additionally obtained outdoors and within the greenhouse. Plant nonwater-stressed baselines, i.e., plots of foliage-air temperature differential versus air vapor pressure deficit for potentially transpiring vegetation were (1) curvilinear, as opposed to the In summer of 1985, several day-long sets of foliage temperature measurements were obtained for air vapor pressure deficit for potentially transpiring vegetation were (1) curvilinear, as opposed to the straight lines often seen with much smaller and restricted data sets, and (2) that these baselines accurately described this basic theory, utilizing independently measured values of plant foliage and aerodynamic resistances to water vapor transport. These findings lead to some slight adjustments in the procedure for calculating the Idso-Jackson plant water stress index and they suggest that plants can adequately respond to much greater atmospheric demands for evaporation than what previously has been believed possible. In addition, they demonstrate that the likely net radiation enhancement due to a doubling of the atmospheric ement due to a doubling of the atmospheric carbon dioxide concentration will have little direct effect on vegetation temperatures, but that the antitranspirant effect of atmospheric CO2 enrichment on foliage temperature may be substantial.
(Author's abstract)

IONIC COMPOSITION OF ISOETES SETA-CEA PLANTS DURING REACTIVATION BY REHYDRATION, (LES TENEURS IONIQUES DES PLANTS D'ISOETES SETACEA AU COURS DE LA REACTIVATION PAR REHY-DRATATION).

Paris-6 Univ. (France). Lab. de Cytologie et Mor-phogense Vegetales. For primary bibliographic entry see Field 2I. W87-04818

INFLUENCE OF MOISTURE STRESS AND IN-DUCED RESISTANCE IN PONDERSOSA PINE, PINUS PONDERSOSA DOUGL EX. LAWS, ON THE PINE SAWFLY, NEODIPRION AUTUMNALIS SMITH,

Northern Arizona Univ., Flagstaff. School of For-

M. R. Wagner.

Forest Ecology and Management FECMDW, Vol. 15, No. 1, p 43-53, May 15, 1986. 2 fig, 1 tab, 28

Descriptors: *Moisture stress, *Pine trees, *Insects, Plant tissues, Plant physiology, Nitrogen, Phenols, Tannins, Defoliation, Field tests, Polyethylene glycol, Induction.

Plant moisture stress was artifically maintained for ponderosa pine seedlings using polyethylene glycol. Stressed seedlings produced significantly lower amounts of needle nitrogen, phenols, and tannins than non-stressed seedlings. Field tests revealed that previously damaged foliage was a significantly poorer food source for the pine sawfly than was non-damaged foliage. Field studies further indicated that the effect of induction by deforming the stress of the significant was more important than the effect of the ther mucated that the effect of induction by defi-liation was more important than the effect of the stress level. Both the level of plant stress and the amount of previous damage influence larval feed-ing and foliage chemistry. A tree damaged from previous defoliation is likely to be quite different in chemistry than a nearby non-defoliated tree. Com-

parison of two such trees might not reveal chemi-cal differences that are responsible for preferential selection. More research is needed to consider the potential effect of removing or damaging foliage has on remaining foliage and its abbecquent suit-ability as a food source for aswfly larvae. (Auabstract)

IRRIGATION SCHEDULING AND WATER-MELON YIELD MODEL FOR THE JORDAN VALLEY, Jordan Univ

Jordan Univ., Amman. For primary bibliographic entry see Field 3F. W87-04852

RYEGRASS ESTABLISHMENT AND YIELD IN RELATION TO PESTICIDE TREATMENT, IR-RIGATION AND FERTILISER LEVEL, Rothamsted Experimental Station, Harpenden For primary bibliographic entry see Field 3F. W87-04857

EFFECTS OF ANTITRANSPIRANTS ON STO-MATAL OPENING AND THE PROLINE AND RELATIVE WATER CONTENTS IN THE

TOMATO, Indian Inst. of Horticultural Research, Bangalore. Div. of Plant Physiology and Biochemistry. For primary bibliographic entry see Field 3F. W37-04861

CONTRIBUTION TO THE STUDY OF BIO-CHEMICAL MECHANISMS OF RESISTANCE TO WATER STRESS: PROLINE ACCUMULA-TION DURING THE VEGETATIVE CYCLE OF TION DURING THE VEGETATIVE CYCLE OF BREAD WHEAT (TRITICUM AESTIVUM L.) AND DURUM WHEAT (TRITICUM DURUM DESF.) (CONTRIBUTION A L'ETUDE DE LA RESISTANCE A LA SECHERESSE CHEZ LE BLE TENDRE (TRITICUM AESTIVUM L.) ET CHEZ LE BLE DUR (TRITICUM DURUM DESF.): ETUDE DE LACCUMULATION DE LA PROLINE AU COURS DE CYCLE DE DEVE-LOPPEMENT), Ecole Nationale Superieure Agronomique de

Montpellier (France).
P. Monneveux, and M. Nemmar.
Agronomie AGRNDZ, Vol. 6, No. 6, p 583-590, 1986. 10 fig, 3 tab, 23 ref.

Descriptors: *Wheat, *Water stress, *Drought resistance, *Proline, *Transpiration, *Plant water potential, Accumulation, Rainfall.

Leaf proline values were followed in bread wheat Leaf proline values were followed in bread wheat and durum wheat during the development cycle and over three years. Proline value was very closely linked to maximal day temperature and to rainfall as well as to the accumulation of the amino acid behaving as a response to water deficit. The varieties tested were classified on the basis of their maximal proline value. Varieties with the highest values are known for their high resistance to drought. Durum wheat varieties have higher values than bread wheat varieties. The classification of varieties within each species was close to values than bread wheat varieties. In classifica-tion of varieties within each species was close to that obtained by measurement of foliar resistance to transpiration. Proline accumulation seems to play an important role as a biochemical mechanism of resistance to water stress and should be used in the search for resistant parents. (Author's abstract)

DIURNAL PATTERNS OF PHOTOSYNTHE-SIS, EVAPOTRANSPIRATION AND WATER USE EFFICIENCY IN MUSTARD AT DIFFER-GROWTH PHASES UNDER FIELD CON-DITIONS.

DITIONS, Haryana Agricultural Univ., Hissar (India). Na-tional Agricultural Research Project. D. P. Singh, P. Singh, and H. C. Sharma. Photosynthetica PHSYB5, Vol. 20, No. 2, p 117-123, 1986. 7 fig, 1 tab, 6 ref.

Descriptors: *Photosynthesis, *Evapotranspira-tion, *Water use efficiency, *Mustard, *Plant

growth, *Field tests, Plant tissues, Temperature effects, India.

effects, India.

The patterns of rates of net photosynthesis, evaporaraspiration and water use efficiency of Indian mustard crop canopy were studied on clear days under field conditions. Photosynthesis increased from the vegetative phase to pod formation and then declined through maturity. The relative contribution of green pods and leaves to canopy photosynthesis was 61.1 and 35.2%, respectively, at the pod formation phase. The diurnal response of net photosynthesis rates to photosynthetically active radiation (PAR) was temperature dependent. On cooler days, net photosynthesis rates were lower for a certain PAR during the first half than the second half of the day, and vice versa on the warmer days. Evaportanspiration was affected both by crop cover and evaporative demand until flower bud initiation and thereafter mainly by evaporative demand. There was a lag of about two hours between maximum net photosynthesis and maximum evaportanspiration. Water use efficiency increased from the vegetative to the flowering stage and declined thereafter until crop maturity. Climatic conditions were favorable for optimization of water use efficiency during cooler months. Maximum water use efficiency was recorded at higher PAR on cooler days. (Author's abstract) W87-04866

EVIDENCE FOR THE PARTICIPATION OF DISSIMILATORY PROCESSES IN MAINTAIN-ING HIGH CARBON FLUXES THROUGH THE PHOTOSYNTHETIC CARBON REDUCTION AND OXIDATION CYCLES IN WATER STRESSED PHASEOLUS LEAVES, Kaiserslautern Univ. (Germany, F.R.). Fachber-

Descriptors: *Carbon, *Photosynthesis, *Phaseolus, *Oxidation, *Water stress, *Plant water potential, Plant tissues, Leaves, Enzymes, Protein, Chlo-

A study was conducted to determine the role that carbon dioxide released from photorespiration, glycolysis, the Krebs cycle or other sources might play in maintaining high carbon fluxes behind almost closed stomata. The content of chloroplast starch and the activities of some of the enzymes almost closed stomata. The content of chloroplast starch and the activities of some of the enzymes involved in dissimilation and reassimiliation of photo-respiratory ammonia in relation to plant water potential were determined. Water stress accelerated the development of Phaseolus vulgaris L. which was expressed by premature development of flowers and susequent production of small fruits. The activities of NADH-3-phosphoglycerate dehydrogenase, glutamine synthetase and glutamate synthase decreased by about 25 to 30% when leaf water potential dropped to severe stress levels, while the activity of NAD-malate dehydrogenase remained unaffected and the activity of NADP-glucose-6-phosphate dehydrogenase increased by about 133%. The decrease in the activities of some enzymes during the stress period was related to the concomitant net loss of soluble protein. The strong increase in the activity of NADP-glucose-6-phosphate dehydrogenase may be due to a function of this enzyme in the dissimilatory process leading to the almost complete degradation of the chlorophast starch during water stress. Significant changes in the content of chlorophyll occurred only at severe stress. While the photosynthetic performance of medium stressed leaves recovered almost completely after rewatering, severely stressed leaves feedow recovered almost completely after rewatering, severely stressed leaves died or recovered by not more than 40%. (Author's abstract)

PHOTOSYNTHETIC RATE AND WATER RE-LATIONS IN SOME FOREST HERBS IN SPRING AND SUMMER, Slovenska Akademia Vied, Bratislava (Czechoalo-vakia). Ustav Experimentalenj Biologie a Ekolo-

For primary bibliographic entry see Field 2I. W87-04868

Streamflow and Runoff—Group 2E

WATERMELON (CTTRULLUS LANATUS) PRODUCTION UNDER MULCH AND TRICK-LE IRRIGATION IN THE JORDAN VALLEY,

Jordan Univ., Amman.
L. Ghawi, and A. M. Battikhi.
Journal of Agronomy and Crop Science
ZAPFAR, Vol. 156, No. 4, p 225-236, May 1986. 4
fig, 6 tab, 15 ref.

Descriptors: *Mulches, *Watermelon, *Jordan, *Trickle irrigation, *Water use efficiency, *Irrigation requirements, *Crop yield, Soil temperature, Root distribution, Irrigation efficiency.

Root distribution, Irrigation efficiency.

The effects of different plastic mulching on crop water use and yields of watermelon were studied in a field experiment in the Jordan Valley. Soil temperature data was also collected in an attempt to study its fluctuation and degree of change under different mulching, and root density and distribution were studied. Results indicated significant differences in water applied and in yields between treatments. Highest yield was obtained under transparent mulch with average total water supply of 44.3 centimeters. An average yield was obtained under balck mulch when only 40.1 centimeters of water was applied. Under no mulch, only about one quarter of the average yield was obtained with a highest total water supply of 51.2 centimeters. Root distribution and density did not show any significant differences. Soil temperatures under mulched treatments were higher than under non-significant difference between transparent and black mulched treatments. (Author's abstract) W87-04877

PHYSIOLOGICAL BASIS OF IRRIGATION SCHEDULING FOR SEED PRODUCTION IN EGYPTIAN CLOVER SYN, BERSEEM (TRIFOLIUM ALEXANDRINUM L.) CROP, Indian Grassland and Fodder Research Inst.

Jhansi For primary bibliographic entry see Field 3F. W87-04878

EFFICIENT IRRIGATION TIMING METHODS

FOR CORN PRODUCTION,
North Dakota State Univ., Fargo. Dept. of Agricultural Engineering. cultural Engineering. Por primary bibliographic entry see Field 3F. W87-04933

ESTIMATING THE EFFECTS OF UNDER-STORY REMOVAL FROM A DOUGLAS FIR FOREST USING A TWO-LAYER CANOPY EVAPOTRANSPIRATION MODEL, British Columbia Univ., Vancouver. Dept. of Soil

F. M. Kelliher, T. A. Black, and D. T. Price. Water Resources Research WRERAQ, Vol. 22, No. 13, p 1891-1899, December 1986. 7 fig, 3 tab,

Descriptors: *Fir trees, *Forest management, *Canopy, *Evapotranspiration, *Mathematical models, *Model studies, Estimating, Equations, Root zone, Boundary layers, Evaporation, Transpiration, Hydrologic budget, Trees.

W. J. Shuttleworth's (1979) development of the Penman-Monteith evaporation equation for multilayer, partially wet forest canopies was modified for application to the hypostomatous canopies of Douglas fir and salal. This theory was combined with standard hourly micrometeorological measurements, eddy diffusive, boundary layer and stomatal resistance functions, and canopy and root zone water balance equations to calculate evaporanspiration rates (E) from a Douglas fir forest with salal understory over extended periods during two growing seasons. Calculated values of E agreed to within 0.2 mm/d of values determined using Bowen ratio-energy balance measurements. agreed to within 0.2 mm/d of values determined using Bowen ratio-energy balance measurements. The courses of average root zone volumetric water content (Theta) calculated for two extended periods agreed well with neutron probe measurements. Salal understory removal resulted in measured values of Theta being only 0.01-0.03 cu m/cu m higher over the two periods, in close agreement

with calculations. This corresponded to calculated tree transpiration rates being 0.4 mm/d higher on average, during the second half of both periods. These higher rates were confirmed by stomatal resistance measurements. (Author's abstract) W87-04952

EFFECTS OF WATER STRESS ON THE OR-GANIC ACID AND CARBOHYDRATE COM-POSITIONS OF COTTON PLANTS,

Agricultural Research Service, New Orleans, LA. Southern Regional Research Center. For primary bibliographic entry see Field 21. W87-05038

OSMOTIC ADJUSTMENT IN LEAVES OF VA MYCORRHIZAL AND NONMYCORRHIZAL ROSE PLANTS IN RESPONSE TO DROUGHT

Washington State Univ., Pullman. Dept. of Horti-culture and Landscape Architecture. For primary bibliographic entry see Field 2I. W87-05039

PHOTOSYNTHETIC RESPONSES OF LEAVES TO WATER STRESS, EXPRESSED BY PHO-TOACOUSTICS AND RELATED METHODS: I. PROBING THE PHOTOACOUSTIC METHOD AS AN INDICATOR FOR WATER STRESS IN VIVO.

nn Inst. of Science, Rehovoth (Israel). Dept. of Biochemistry.
For primary bibliographic entry see Field 2I.
W87-05040

PHOTOSYNTHETIC RESPONSES OF LEAVES TO WATER STRESS, EXPRESSED BY PHO-TOACOUSTICS AND RELATED METHODS: II. THE EFFECT OF RAPID DROUGHT ON THE ELECTRON TRANSPORT AND THE RELA-TIVE ACTIVITIES OF THE TWO PHOTOSYS-

in Inst. of Science, Rehovoth (Israel). Dept. of Biochemistry.
For primary bibliographic entry see Field 2I.

W87-05041

NONSTEADY-STATE ANALYSIS OF WATER FLOW AND CAPACITANCE FOR AGAVE DE-SERTI

SERTI, California Univ., Los Angeles. Dept. of Biology. H. W. Calkin, and P. S. Nobel. Canadian Journal of Botany CJBOAW, Vol. 64, No. 11, p 2556-2560, November 1986. 7 fig, 1 tab, 26 ref. NSF Grant BSR84-14455.

Descriptors: *Plant water potential, *Descri plants, *Evapotranspiration, *Transpiration, *Succulents, *Measuring instruments, *Soil water potential, Simulation, Capacitance, Resistance, Leaves, Cells, Drought, Prediction, Metabolism.

An analog electrical circuit, including both resistances and capacitances for roots, stem, and leaves, was developed for a desert leaf-aucculent, Agave deserti. Based on soil water potentials and observed transpiration rates and the influence of leaf, stem, and root relative water content on the water potential of each organ, water potential could be predicted at various locations in the transpiration stream. Simulations indicated that as stomata opened at night for this crassulacean acid-metabolism plant, most of the water initially transpired came from the leaves. Water movement from the soil was greatest throughout the night and the early morning; the maximal water uptake rate from the soil was only about half of the maximum transpiration rate. As drought increased, lower transpiration rates led to smaller water losses, in turn leading to progressively earlier recharge of the leaf capacitance. The substantial and predictable daily changes in plant water potential may have profound effects on physiological processes in the cells near the transpiration stream. (Author's abstract) abstract) W87-05060

2E. Streamflow and Runoff

MEANDER FLOW MODEL I: DEVELOP-MENT, Iowa Univ., Iowa City. Dept. of Civil Engineer-

ing.
A. J. Odgaard.
Journal of Hydraulic Engineering JHEND8, Vol. 112, No. 12, p 1117-1136, December 1986. 7 fig. 22 ref. NSF Grant MSM-8308470.

Descriptors: *Channel morphology, *Sediment transport, *Meanders, *Mathematical models, *Alluvial channels, Bed topography, Mathematical equations, Streambeds, Froude number, Bed stability, Mathematical equations, Channel curvature, Flow models.

A model was developed for simulating the flow and bed topography in a meandering channel. The basis of the simulation is a solution to the equations for conservation of mass and momentum and for lateral stability of the streambed. The bed-stability equation uses a transverse force balance for bed-sediment particles relating the transverse bed slope to primary flow variables. The main controlling parameters are the channel's width-depth ratio, radius-width ratio, resistance characteristics (or gradient), and sediment Froude number. An innovative feature is the use of a simple mass-flux balance (mass conservation) to link the equation for bed stability to the momentum equations. The mass-flux balance related the net interal transport of flow volume to the streamwise variation of transverse bed slope. The equations governing the secondary-current velocity and the transverse bed slope became those of a damped oscillating system subjected to a driving force, the change in channel curvature. The model was tested with both laboratory and field data. (See also W87-04389) (Author's abstract) A model was developed for simulating the flow abstract) W87-04388

MEANDER FLOW MODEL II: APPLICA-

TIONS, Iowa Univ., Iowa City. Dept. of Civil Engineer-

ing.
A. J. Odgaard.
Journal of Hydraulic Engineering JHEND8, Vol.
112, No. 12, p 1137-1150, December 1986. 8 fig, 3 tab, 10 ref. NSF Grant MSM-8308470.

Descriptors: *Channel morphology, *Sediment transport, *Meanders, *Alluvial channels, *Mathematical models, Mathematical equations, Bed scour, Erosion, Bank protection, Muddy Creek, Fall River, Streambeds, Flow models, Topogra-

An analytical model for simulating the flow and bed topography in a meandering alluvial channel was tested with data taken from previous field studies of sections of Fall River, Rocky Mountain National Park and of Muddy Creek in western Wyoming. The Fall River data was used for testing a technique which involves discretizing the river channel into a number of straight and constant-radius reaches, and solving a set of governing equations for each reach, using appropriate boundary conditions. The Muddy River data was used for testing a solution for a sequence of sine generfor testing a solution for a sequence of sine generated meander curves. In both cases the simulated flow and bed features were in good agreement with those measured. The agreement was obtained without use of calibration factors. With its ability without use of cantoration ractors. With its solutive to predict both magnitude and location of bed scour near outer banks in meander curves, the model should be a useful tool for the design of bank-protection structures. (See also W87-04388) (Wood-PTT) W87-04389)

FRICTION SLOPE AVERAGING IN BACKWA-

TER CALCULATIONS, Monash Univ., Clayton (Australia). Dept. of Civil

Engineering. E. M. Laurenson.
Journal of Hydraulic Engineering JHEND8, Vol.
112, No. 12, p 1151-1163, December 1986. 5 fig. 1
tab, 5 ref.

Group 2E-Streamflow and Runoff

Descriptors: *Backwater, *Water surface profiles, *Mathematical studies, Friction slope averaging, Calculations, Mathematical equations, Reach, Water levels, Channels, Nonuniform flow.

In calculating water surface profiles, the average friction slope is estimated from conditions at the ends of a reach. Methods used to approximate the average slope include use of the arithmetic, geometric, and harmonic means of reach-end friction slopes, and the arithmetic mean of the reach-end slopes, and the arithmetic mean of the reach-end conveyances. Systematic variations exist in the slopes, and consequently the water levels, calculated by the various methods. The errors in slope tend to be negative which underestimates the water levels. Previous known investigations of the methods are limited, in their application, to prismatic channels. For irregular channels, the true friction slope line can be approximated by a third degree polynomial. Differences between the various approximations and the true average slope of such a curve showed that the arithmetic mean of the reach-end friction slopes had the lowest maximum error but did not always give the smallest error. Its use was suggested, coupled with systematic selection of cross section locations and occasional use of the geometric mean of reach-end sional use of the geometric mean of reach-end slopes. (Author's abstract)

RECORD ST. CLAIR RIVER ICE JAM OF 1984. National Oceanic and Atmospheric Administra-tion, Ann Arbor, MI. Great Lakes Environmental For primary bibliographic entry see Field 2C. W87-04392

RESOURCE PARTITIONING OF FOOD PAR-TICLES BETWEEN ASSOCIATED LARVAE OF PROSIMULIUM RUFIPES AND EUSIMU-LIUM CRYOPHILUM (DIPTERA, SIMULII-DAE) IN AUSTRIAN MOUNTAIN BROOKS, Konstanz Univ. (Germany, F.R.). Fakultaet fuer

Konstanz Charles Biologie.

Biologie.
P. Schroder.
Archiv fuer Hydrobiologie AHYBA4, Vol. 107, No. 4, p 497-509, October 1986. 4 fig. 5 tab, 27 ref.

*Competing use,

Descriptors: *Food chains, *Competing use, *Blackflies, *Food partitioning, *Streams, *Algae, *Detritus, Larvae, Jacobo electivity index D, Diatoms, Niches, Austria.

toms, Niches, Austria.

In June 1984 larvae of the blackfly species Eusimulium cryophilum and Prosimulium rufipes were collected in two small mountain streams in the Bregenzer Wald in Austria at 1600m above sea level. Comparisons between the particle distribution of food supply suspended in the current and their proportions in the larval guts of the blackfly species showed intra- and interspecific differences. The proportion of large particles increased with increasing larval size in most cases. Detritus particles and distoms always were overrepresented in the larval guts compared with their proportions in the food supply. Furthermore, the percentage of detritus increased in the larval gut of Prosimulium rufipes. The proportion of other algae was always lower in the larval guts than in the food supply. To quantify these differences the Jacobe' electivity index D was calculated. It was concluded that there is only small miche overlap in food utilization between two was calculated. It was concluded that there is only small niche overlap in food utilization between two associated species which were divided into differ-ent feeding types, while larvae of the same feeding type need niche separation of food utilization, space and time for successful coexistence. (Au-thor's abstract) thor's abstract)

LIGNIN AND FIBER CONTENT OF FPOM GENERATED BY THE SHREDDERS TIPULA ABDOMINALIS (DIPTERA: TIPULIDAE) AND TALLAPERIA CORNELIA (NEEDHAM AND SMITH) (PLECOPTERA: PELTOPERLIDAE), Albame Livis, University David Bisland, Alabama Univ., University. Dept. of Biology. For primary bibliographic entry see Field 2H.

HYBRID METHOD FOR SEASO STREAMFLOW FORECASTING, Asian Inst. of Tech., Bangkok (Thailand). For primary bibliographic entry see Field 7A. W87-04480 SEASONAL

APPROACH TO THE MATHEMATICAL EX-PRESSION OF RECESSION CURVES, Hydrological Research Inst., Pretoria (South Africa). I. Petras.

Water S. A. WASADV, Vol. 12, No. 3, p 145-150, July 1986. 5 fig, 2 tab, 7 ref.

Descriptors: *Mathematical equations, *Hydrograph analysis, *Surface groundwater relations, *Mathematical analysis, *Recession curves, *Hydrographs, *Runoff, *Groundwater storage, Mean recession curve, Envelope recession curve, Base

A recession curve of any origin can be mathemati-A recession curve of any origin can be mathemati-cally expressed by a superimposition of the expo-nential equation Q sub 0 x e to the minus alpha to power, and evaluated from its basic parameters alpha (depletion coefficient) and Q sub 0 (initial discharge). The expression of curves of various gradients and curvature by the same formula en-ables their comparison on an equal basis. In order to expand this facility the method for the construc-tion of the mean and envelope recession curves ables their comparison on an equal basis. In order to expand this facility the method for the construction of the mean and envelope recession curves from curves expressed by the above-mentioned relationship was developed. The method was demonstrated on the basis of nine curves from the outlet section of the Luano Catchment A (Zatchment A (Xarone-PTT) W87-04485)

CONCAVE-BANK BENCHES IN THE FLOOD-PLAINS OF MUSEWA AND FORT NELSON RIVERS, BRITISH COLUMBIA, Simon Fraser Univ., Burnaby (British Columbia). For primary bibliographic entry see Field 2J. W87-04522

CLEARCUTTING AND THE BIOGEOCHE-MISTRY OF STREAMWATER IN NEW ENG-LAND, Northeastern Forest Experiment Station, Durham, NH For primary bibliographic entry see Field 5C. W87-04542

FREQUENCY ANALYSIS OF LOW FLOWS: HYPOTHETICAL DISTRIBUTION METHODS AND A PHYSICALLY BASED APPROACH, Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.

G. V. Loganathan, P. Mattejat, C. Y. Kuo, and M. U. Neitzien.

Nordic Hydrology NOHYBB, Vol. 17, No. 3, p 129-150, 1986. 2 fig, 32 ref, append.

Descriptors: *Mathematical models, *Streamflow, *Hydrographs, *Streams, *Frequency analysis, *Low flow, *Probability distribution, Statistical analysis, Statistical methods, Mathematical studies.

Accurate prediction of low flows is required for effective management of streamflow to meet all demands and water quality needs. A mixed log Pearson type III distribution, a double bounded probability density function, partial duration series and a physically based approach are analyzed for frequency estimates of low flows. The mixed log Pearson type III involves a point probability mass at zero for intermittent streams. The double bounded probability distribution has lower and upper bounds with a point mass at the lower bound. Two bounds with a point mass at the lower bound. Two approaches are used in partial duration series; truncation and censoring which represent curtailing of the population and the sample respectively. The parameters are estimated by the maximum likelihood procedure. Considering low flows as part of the recession limb of stream flow hydrographs a physically based approach is formulated. By using the exponential decay of stream recessions and considering the initial recession flows, recession durations, and recharge due to incoming storms as

statistically independent random variables, a first order random coefficient Markov model for initial recession flows is formed. The resulting steady state probability distribution for initial recession flows is combined with the probability distribution of the exponential decay to obtain the probabilities of low flow events. The methods are applied to both perennial and intermittent streams. (Author's abstract')

ATTEMPTING FLOW FORECASTS OF THE INDUS RIVER, PAKISTAN, USING REMOTELY SENSED SNOW COVER DATA, Waterloo Univ. (Ontario).

M. T. A. Makhdoom, and S. I. Soloman.
Nordic Hydrology NOHYBB, Vol. 17, No. 3, p 171-184, 1986. 2 fig. 3 tab, 9 ref.

Descriptors: *Snowmelt, *River flow, *Flow fore-casting. *Mathematical studies, *Indus River, *Remote sensing, *Snow cover, *Runoff, Predic-tion, Pakistan, Weather data collections, Perform-

Recent developments in collection and interpreta-tion of remotely sensed back radiation data from the earth surface obtained by satellites has made it possible to readily delineate areas covered by snow on the earth surface. In view of this, attempts were intensified during the last decade to generate statis-tical relationships between the snow covered areas in the basin and the corresponding runoff during the snow melt period. However examination of the snow melt period. However examination of such relationships developed specifically for foreasting purposes in the Indus river basin in Pakistan indicates that, given the current data and operational constraints, their usefulness is very limited. The need for improving collection of remotely sensed data on snow to obtain information on snow density and other auxiliary information is emphasized. (Author's abstract)

MULTIVARIATE TRANSFER FUNCTION-NOISE MODEL OF RIVER FLOW FOR HY-DROPOWER OPERATION, Queen's Univ., Kingston (Ontario). Dept. of Civil

Engineering.
T. Olason, and W. E. Watt.
Nordic Hydrology NOHYBB, Vol. 17, No. 3, p
185-202, 1986. 9 fig. 13 tab, 21 ref.

Descriptors: *Rivers, *Flow forecasting, *Multi-variate analysis, *Statistical analysis, *Statistical models, *River flow forecasting, *Time series models, *Mathematical models, Hydroelectric power, Ontario, Calibrations.

Effective scheduling of hydroelectric power pro duction requires good long and short term forecasts of flows. Short term flow forecasts can be
made only with some type of real time flow forecasting system. Multivariate time series model in
their transfer function-noise form are very applicable to multiple routing problems and lend themselves readily to real time forecasting. The formulation of Multivariate auto regressive moving average (ARMA) time series models and their transfer
function noise (TFN) is described. Development of
a multivariate TFN model is difficult if the multiple inputs are correlated. Various methods for
developing multivariate TFN models with correlated multiple inputs are critically reviewed. A
simple approach to developing multiple input TFN
models with correlated inputs is described. This
approach is successfully applied to developing a
forecasting model for average daily flow of the
Mattagami River at Little Long Generation Station in Northern Ontario, Canada. System inputs
are upstream and tributary flows. Only three years
of daily data for the period April 1st to October
31st were required to calibrate the model. Two
further years were used to verify the model. Forecasts at lead times of one and two days were good
for both calibration and verification periods. The
average standard errors were 8 per cent of average
inflows (1 day lead) and 18 per cent (2 day lead).
The system produces significantly better forecasts
than a univariate time series model. (Author's abstract) duction requires good long and short term fore-casts of flows. Short term flow forecasts can be

W87-04556

SIMPLE AND EFFICIENT CONCEPTUAL CATCHMENT MODEL ALLOWING FOR SPATIAL VARIATION IN RAINFALL, Lund Univ. (Sweden). Dept. of Water Resources

Luna Unix. Charles and R. Berndtsson.
V. L. Nguyen, and R. Berndtsson.
Hydrological Sciences Journal HSJODN, Vol. 31, No. 4, p 475-487, December 1986. 7 fig, 2 tab, 13

Descriptors: "Rainfall-runoff relationships, "Rainfall, "Runoff, "Spatial distribution, "Catchment areas, "Streamflow forecasting, "Runoff forecasting, "Hydrologic models, "Model studies, "Mathematical models, Areal precipitation, Algorithms, Water resources development, Tunisia.

Water resources development, Tunisia.

In developing countries, the use of mathematical models in hydrological forecasting is increasing, making for optimal planning and management of water resource systems. Such application, however, faces different problems. One of these problems is that computers may not be available. Even if they are available, computer time is expensive. Hence, there is a need for simple models which can be run on pocket calculators or which are computer time efficient, with high accuracy. A rainfall runoff model with a very simple structure is presented. With simple algorithms the model can be used with computers with a small memory. A method for estimating the mean areal rainfall, representing the detailed distribution of rain over an area is also put forward. The model has been applied to a small, mainly rural catchment in Northern Tunisia for both single rainfall event simulation and continuous simulation for longer periods. The outcome was most encouraging, with measured and calculated streamflows presented and discussed. (Author's abstract) and discussed. (Author's abstract) W87-04559

EFFECT OF DEFORESTATION AND SUBSIST-ENCE AGRICULTURE ON RUNOFF OF THE KAFUE RIVER HEADWATERS, ZAMBIA, National Council for Scientific Research, Lusaka (Zambia). Water Resources Research Unit.

(Zamona), water reconstruction A. Mumeka. Hydrological Sciences Journal HSJODN, Vol. 31, No. 4, p 543-554, December 1986. 6 fig. 3 tab, 12

Descriptors: *Deforestation, *Subsistence agriculture, *Tropical forests, *Runoff, *Catchment areas, Streamflow, Zambia, Hydrographs, Agriculture, Cultivated lands.

The observed effects on the streamflow of changing a tropical forest in the high rainfall belt of Zambia to agricultural use based on traditional farming methods are presented. Hydrological observations were carried out on four small catches the control of the servations were carried out on four small catchments under their natural conditions first, and later two of them under agricultural use with accompanying deforestation. Simple linear regression analysis of both monthly and annual runoff from undisturbed catchments showed that there was an increase in streamflow as a result of deforestation and subsistence agriculture. It is also shown that the shape of the flood hydrograph was changed as a result of the land use. (Author's abstract) W87-04564

UPLAND AFFORESTATION: INFLUENCES ON STREAM HYDROLOGY AND CHEMIS-TRY, Institute of Terrestrial Ecology, Bangor (Wales). Bangor Research Station.

For primary bibliographic entry see Field 4C. W87-04574

ESTIMATING CATCHMENT WATER QUALITY RESPONSE TO ACID DEPOSITION USING MATHEMATICAL MODELS OF SOIL ION EXCHANGE PROCESSES, Virginia Univ., Charlottesville.
For primary bibliographic entry see Field 5C.
W87-04587

CLIMATIC MODEL OF RUNOFF-DRIVEN COASTAL CIRCULATION, British Columbia Univ., Vancouver. Dept. of British Columbia Univ., Vancouver. Dep Oceanography. For primary bibliographic entry see Field 2L W87-0469

WATER QUALITY OF AGRICULTURAL COASTAL PLAIN WATERSHEDS, Delaware Univ., Newark. Dept. of Agricultural For primary bibliographic entry see Field 5B. W87-04625

STATUS OF THE FRESHWATER PEARL MUSSEL MARGARITIFERA MARGARITI-FERA L. IN THE SOUTH OF ITS EUROPEAN RANGE, Bayreuth Univ. (Germany, F.R.). Dept. of Animal

For primary bibliographic entry see Field 5C. W87-04656 Ecology.

HYDRAULICS OF FLOODPLAIN FLOWS,

Y. N. Sokolov. Hydrotechnical Construction HYCOAR, Vol. 20, No. 5, p 272-277, May 1986. 3 fig, 11 ref. Translat-ed from Gidrotekhnichesko Stroitel'stvo No. 5, p 14-17, May 1986. tvo No. 5, p

Descriptors: *Hydraulic roughness, *Floods, *Vegetation effects, *Flood plains, *Roughness coefficient, Mathematical equations, United States, Soviet Union, Equations, Rivers.

A method of determining the hydraulic roughness of individual plant species was developed and employed along with a generalized vegetation parameter in the equation for the hydraulic roughness coefficient. The relation between the roughness coefficient and the generalized vegetation parameter was determined both in the laboratory and for the USA and USSR. The roughness coefficients in the USA and USSR. The roughness coefficients are used to the user the user that th coefficient and the generalized vegetation parameter was determined both in the laboratory and for rivers in the USA and USSR. The roughness coefficient due to vegetation, $n_i = f'(P(I/d))$, where P is the generalized vegetation parameter, I is the distance along the length of flow between roughness elements, and I is its characteristic dimension. The vegetation parameter, $P_i = 1$ is the most elements, and I is its characteristic dimension. The vegetation parameter, $P_i = 1$ is the horizontal projection of the vegetation, I sub I is the horizontal projection of the vegetation, has I is the horizontal projection of the vegetation inundated with water, I sub I is the depth of the floodplain flow, I is a linear dimension characteristic stretch of the floodplain, and delta is a parameter accounting for the degree of vertical continuity of multiple stem, I e.g., ahrub vegetation. The subscript I corresponds to the types of vegetation or other obstacle; for floating plant remains held back by trees, I = I, for shrubs, I = I, and so on. In natural floodplains I/I is typically at least 20-30, so that for practical purposes I = I (Rochester-PTT) W87-04768

IDENTIFYING HYDRO RESOURCES WITH ENHANCED SATELLITE IMAGERY, Watermeyer, Legge, Piesold and Uhlmann, Ashford (England). For primary bibliographic entry see Field 7B. W87-04779

RECOMMENDATION FOR FLOOD DAMAGE REDUCTION AT WASTEWATER TREATMENT

na River Basin Commission, Harrisburg, For primary bibliographic entry see Field 5D. W87-04807

SOVIETS SHELVE PLAN ON DIVERTING RIVERS IN ARCTIC REGIONS, For primary bibliographic entry see Field 4A. For primary W87-04844

HYDROLOGY OF ALLUVIAL STREAM CHANNELS IN SOUTHERN COASTAL PLAIN WATERSHEDS,

Streamflow and Runoff-Group 2E

Georgia Univ., Athens. Dept. of Agricultural En-A. Shirmohammadi, J. M. Sheridan, and L. E.

Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 135-142, January-February 1986. 13 fig, 4 tab, 15 ref.

Descriptors: *Alluvial aquifers, *Alluvial streams, *Surface-groundwater relations, *Channels, *Coastal plains, *Watersheds, *Rainfall, *Ground-water, *Stream discharge, Hydrology, Soil maps, Seasonal variation, Evapotranspiration, Storms, Alluvial storage, Peak discharge.

Since water management includes consideration of water quality as well as water quantity, proper characterization of hydrologic cycle components, and sources and sinks for both water and chemicals in a watershed is even more critical. Thirteen years of recorded rainfall, streamflow, and groundwater elevation data were used to analyze the hydrologic characteristics of the alluvial stream channels for three subwatersheds in the Coastal Plain of the southeastern U.S. Drainage areas of these subwatersheds range from 16.7 sq km to 30 sq km. Digitized soil maps and cross-sectional transecta were used to determine alluvial areal extent and alluvial depth, respectively. These data were used to compute the total alluvial volumes in each subwatershed. Total alluvial depths and total alluvial volumes with groundwater elevation data were watershed. Total alluvial depths and total alluvial volumes with groundwater elevation data were then used to determine the alluvial antecedent conditions and available alluvial storage for three subwatersheds. Results indicate that the available alluvial storage varies with both time of year and antecedent rainfall conditions. Lower available storage was observed for late winter and early spring due to higher rainfall and lowered evaporanspiration. Gradually increasing values were observed during summer and autumn due to lower rainfall and higher evapotranspiration. Results also indicate the effect of alluvial antecendent conditions on instantaneous peak discharge responses. For comparable storms, instantaneous peak discharge rates were higher by an order of magnitude for wet conditions than for dry conditions. (Alexander-PTT) W87-04924

EXPLICIT NUMERICAL SCHEMES FOR UN-STEADY FREE-SURFACE FLOWS WITH

Florida International Univ., Miami. Dept. of Civil and Environmental Engineering.

R. J. Fennems, and M. H. Chaudhry.

Water Resources Research WRERAQ, Vol. 22,
No. 13, p 1923-1930, December 1986. 10 fig. 20 ref.

Descriptors: *Unsteady flow, *Open channel flow, *Bores, *Tidal bores, *Surface flow, *Channel flow, *Model studies, *Computers, *Mathematical equations, Numerical analysis, Viscosity, Computer programs, Rivers, Canals, Equations.

er programs, Rivers, Canaís, Equations.

The unsteady flows in open channels, such as rivers or canals, are often modeled as one-dimensional flows. Such flows are described by a set of quasi-linear, hyperbolic partial differential equations, called the Saint-Venant equations. Since a closed-form solution of these equations is not available, except in special simplified cases, numerical methods have been used to integrate them. In cases where the assumptions of one-dimensional flow and hydrostatic pressure distribution are valid, the agreement between the measured and computed results is usually satisfactory. However, once a shock or bore is formed, special steps become necessary to properly analyze these flows. Three second-order accurate, explicit finite-difference schemes (MacCormack, Lambda, and Gabutti) are introduced and compared for the analysis of unsteady, free-surface flows having shocks or bores. The details of these schemes, their shock-capturing capabilities, stability restrictions, boundary conditions, and use of artificial viscosity to dampen the numerical oscillations near the shock are presented. Computed results are compared with the analytical solution to demonstrate their validity, A comparison of the computer time required for reproducing the shocks with a similar accuracy shows that the Preissmann's implicit scheme takes

Group 2E-Streamflow and Runoff

four to eight times the CPU time taken by these explicit schemes. Because the latter are easier to program, it makes them attractive for real-life applications. (Alexander-PTT) W87-04934

MODEL FOR WETLAND SURFACE WATER

MODEL FOR WETLAND SURFACE WATER DYNAMICS, Michigan Science and Engineering Associates, Ann Arbor. D. E. Hammer, and R. H. Kadlec. Water Resources Research WRERAQ, Vol. 22, No. 13, p 1951-1958, December 1986. 7 fig, 1 tab, 28 ref.

The recognition of the importance and value of our wetlands has accelerated research to reach a better understanding of these ecosystems. The complex interactions between biota, soils, and water are driven first and foremost by the hydrology of the wetland. Much of the work to date has been extended to the property of the wetland. Much of the work to date has been extended to the property of the wetland. gy of the wetland. Much of the work to date has stopped short of providing quantitative and definitive answers to questions involving nutrient cycling sediment transport, and pollutant removal because of our inability to accurately measure water movement in wetlands. The dynamics of wetlands have been represented by a variety of ecological models, often involving great detail and complexity, but few spatially distributed models have emerged. A mathematical model for overland flow through vegetated areas was developed. Input information includes site topography and porosities, power law parameters for the velocity correlation, and the driving forces: precipitation, evapotranspiration, stream flows, groundwater recharge or discharge, and pumped additiona. Depths and flow rates are then calculated as functions of position and time. A one-dimensional algorithm was developed to execute these calculations. tions of position and time. A one-dimensional algo-rithm was developed to execute these calculations. Numerical solutions to the nonlinear partial differ-ential equations were accomplished using special finite difference approximations. The method per-mits long simulation times (several years), without significant material balance errors. The model and simulator were validated using data from the Porter Ranch peatiand located near Houghton Lake, Michigan. (Alexander-PTT) W87-04957

GENERALIZED STOCHASTIC HYDROME-TEOROLOGICAL MODEL FOR FLOOD AND FLASH-FLOOD FORECASTING: 1. FORMULA-TION

Tron, Lowa Univ., Iowa City. Dept. of Civil and Environmental Engineering. K. P. Georgakakos. Water Resources Research WRERAQ, Vol. 22, No. 13, p 2083-2095, December 1986. 12 fig, 6 tab,

Descriptors: "Model studies, "Hydrometeorologi-cal models, "Precipitation, "Streamflow, "Soil moisture, "Flood forecasting, "Flash floods, "Rain-fall-runoff relationships, Stochastic process, Equa-tions, Hydrology, Floods, Prediction.

It has been common practice among hydrologists involved in real-time forecasting of floods to develop rainfall-runoff models that simulate soil and channel processes and utilize precipitation rates as input. The lack of reliable and flexible precipitation models untable for the spatial and temporal scales of the hydrologic processes has prevented the formulation of generalized models that simulated precipitation, soil, and channel processes. An attempt was made to couple meteorological and hydrological models and procedures within the real-time flood forecasting framework. A local quantitative precipitation model was coupled to a soil model and a channel routing model through mass conservation differential equations and an automatic updating procedure. Automatic updating is performed through the use of the Extended Kalman

Filter that provides the capability for real-time probabilistic forecasts of flood occurrence and flood magnitude. To complement the coupled system, a methodology was developed for consistent spatial interpolation of sparse observations of the pertinent meteorological input variables. The interpolation methodology takes into account to occurrence of the property o interpolation methodology takes into account topographic relief and atmospheric lapse rates. The result of the modeling effort is a stochastic-dynamic hydrometeorological system suitable for use in real-time flood and flash-flood forecasting. The application of the model is illustrated by two case studies: one at Tulsa, Oklahoma and the other at Lewiston, Montana. (See also W87-04969) (Alexr-PTT)

GENERALIZED STOCHASTIC HYDROME-TEOROLOGICAL MODEL FOR FLOOD AND FLASH-FLOOD FORECASTING: 2. CASE

FLASH-FLOUD STUDIES, Iowa Univ., Iowa City. Dept. of Civil and Envi-ronmental Engineering. K. P. Georgakakos. Water Resources Research WRERAQ, Vol. 22, No. 13, p 2096-2106, December 1986. 16 fig, 5 tab, 11 ref.

Descriptors: *Rainfall-runoff relationships, *Model studies, *Precipitation, *Streamflow, *Hydrometeorological models, *Flood forecasting, *Flash floods, Soil moisture, Case studies, Performance evaluation, Stochastic process, Floods, Prediction, Oklahoma.

An integrated hydrometeorological model was developed which combines components simulating precipitation, soil, and channel processes, in a conprecipitation, soil, and channel processes, in a conceptual manner, to produce forecasts of both mean areal precipitation and outflow discharge rate. The short- and long-term performance of this model in real-time flood flow forecasting was examined with 6-hourly data from the 2344 sq km Bird Creek Basin in Oklahoma. The model couples a local precipitation model with a soil and a channel model through (1) the conservation of mass law and (2) an extended Kalman filter. The input consists of surface meteorological data interpolated from observations at nearby National Weather Service stations. Hydrograph peak time and magnitude errors were quantified in an effort to judge performance from an operational hydrologist's point of view. Least squares criteria are also utipoint of view. Least squares criteria are also utilized. The effect of the use of forecasts of the input variables on model performance, at various fore-cast lead times, is indicated. Good overall performance of the model was observed with obvious hydrologic performance deterioration when no precipitation component was used. (See also W87-04968) (Alexander-PTT) W87-04968

NOTE ON NONLINEAR STORAGE ROUTING, Vanderbilt Univ., Nashville, TN. Dept. of Civil and Environmental Engineering. A. D. Koussis, and B. J. Osborne. Water Resources Research WRERAQ, Vol. 22, No. 13, p 2111-2113, December 1986. 1 tab, 13 ref.

Descriptors: *Flood routing, *Storage routing, *Dynamic waves, *Flood hydrology, *Mathematical models, Muskingum method, Algorithms, Comparison studies, Floods, Watersheds, Hydrology, Prediction.

The availability of powerful computers has made routine use of complete dynamic wave routing feasible. Nevertheless, conceptual storage models should remain useful tools in flood hydrology with applications in flood management, preliminary hydraulic design, on-line stochastic flood prediction, and as components of distributed watershed models. Parameter estimates for a conceptual, nonlinear storage routing model were derived on the linear storage routing model were derived on the basis of wave theory. An iterative solution scheme basis of wave theory. An iterative solution science for the nonlinear storage routing model was ana-lyzed with respect to its convergence and com-pared in an application to quasi-nonlinear and to linear-storage routing schemes of the Muskingum type. The comparison shows that a noniterative, quasi nonlinear scheme is an excellent substitute

for the fully nonlinear storage algorithm. (Alexander-PTT)

DESIGN OF NATIONAL, REAL-TIME WARNING SYSTEMS WITH CAPABILITY FOR SITE-SPECIFIC, FLASH-FLOOD FORECASTS, Iowa Univ., Iowa City. Dept. of Civil Engineer-For primary bibliographic entry see Field 7A. W87-04976

TROPHIC STRUCTURE IN SOUTHERN ON-TARIO STREAMS, Guelph Univ. (Ontario). Dept. of Zoology. For primary bibliographic entry see Field 2H. W87-05010

EFFECTS OF SMALL IMPOUNDMENTS ON HYDROPSYCHID CADDISFLY PRODUCTION IN VALLEY CREEK, MINNESOTA, Toronto Univ. (Ontario). Dept. of Zoology. For primary bibliographic entry see Field 2H. W87-05011

DAM-BREACH FLOOD WAVE MODELS, Texas A and M Univ., College Station. Dept. of Civil Engineering. For primary bibliographic entry see Field 8B. W87-05022

ANALYSIS OF NONLINEAR MUSKINGUM FLOOD ROUTING, Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
V. P. Singh, and P. D. Scarlatos.
Journal of Hydraulic Engineering (ASCE)
JHEND8, Vol. 113, No. 1, p 61-79, January 1987.
6 fig, 4 tab, 19 ref, append.

Descriptors: *Flood routing, *Muskingum method, *Mathematical equations, *Model studies, *Hydrodynamic equations, *Comparison studies, Inflowoutflow, Hydrographs, Sensitivity analysis.

Flood routing is required for proper management and design of many environmental and water resources projects. The most accurate theoretical approach to flood routing is the system of the St. Venant hydrodynamic equations. This is a nonlinear partial differential hyperbolic system that cannot in general be solved analytically. Numerical techniques such as finite differences or finite elements along with digital computers must be utilized for solution of the complete St. Venant system. However, many less complicated methods have been developed for flood routing problems and have been found satisfactory in many practical applications. The three-parameter nonlinear Muskingum method for flood routing is analyzed. Analytical solutions for simplifying cases and approxikingum method for flood routing is analyzed. Analytical solutions for simplifying cases and approximate integral solutions for general cases are derived. Its accuracy depends mainly on the parameter k. Unlike the linear case, the weighting factor is much less significant. A comparison with the linear case using four sets of inflow-outflow data shows that the nonlinear method is less accurate than its linear counterpart. Also, the accuracy varies from one nonlinear version to another. (Alexander-PTT)

SEASONAL DYNAMICS OF PHOSPHORUS PARTITIONING AND EXPORT IN STREAMS IN ALBERTA, CANADA, Alberta Univ., Edmonton. Dept. of Zoology. For primary bibliographic entry see Field 5B. W87-05052

2F. Groundwater

HYDROGEOLOGICAL PARAMETER ESTIMA-TION FROM PUMP TESTS ON A LARGE DI-AMETER WELL, National Geophysical Research Inst., Hyderabad (India).

Groundwater—Group 2F

V. S. Singh, and C. P. Gupta. Journal of Hydrology JHYDA7, Vol. 87, No. 3/4, p 223-232, October 30, 1986. 5 fig, 1 tab, 8 ref, 2

Descriptors: *Hydrogeology, *Pumping tests, *Wells, *Mathematical models, *Computer programs, *Aquifers, *Groundwater, Numerical modeling, Mathematical studies, Mathematical equations, Drawdown, Field tests, India.

A versatile and easy method using numerical modeling was presented for the estimation of aquifer parameters from pump tests on a large diameter well. The method is applicable even when the abstraction rate is not constant during the pump test. All observational data during the pumping and recovery phases were used in the estimation of the aquifer parameters. A field example of the pump test carried out on a well of diameter 7.2m located in the granitic terrain of the Anantapur district of Andhra Pradesh, India was presented to illustrate the method. The computer program writen in BASIC was shown. It can be executed on a hand held calculator enabling aquifer characteristics to be determined in the field itself. (Wood-PTT) PTT) W87-04395

DIGITAL SIMULATION MODEL FOR THE UNSTEADY-STATE RADIAL FLOW TO A DUG WELL,

WELL, Centre for Water Resources Development and Management, Calicut (India). Ground Water Div. S. P. Rajagopalan, and U. V. Jose. Journal of Hydrology JHYDA7, Vol. 87, No. 3/4, p 233-244, October 30, 1986. 3 fig, 3 tab, 13 ref.

Descriptors: *Simulation models, *Groundwater, *Groundwater movement, *Unsteady flow, *Dug wells, *Radial flow, *Model studies, Aquifers, Algorithms, Mathematical studies, Lateral permeability, Anisotropy, Hydraulic head, Pumping tests.

A digital simulation model was presented for the solution of the unsteady-state radial flow to a large-diameter dug well perforating the full saturated thickness of an unconfined aquifer. The numerical solution was based on the finite difference approach. The computational algorithm was an iterative version of the alternating direction implicit method. The time variant discharge from the aquifer, and the reduction in saturated thickness aquifer, and the reduction in saturated interaction and recovery phases were suitably incorporated in the simulation model. The simulation model could also handle conditions of partial penetration of the duz well as long as it was assumed that the of the dug well as long as it was assumed that the groundwater flow from the aquifer into the well was confined only along the vertical face of the well with no contribution from the bottom face of well with no contribution from the bottom face of the well. A sensitivity analysis was carried out on the model parameters of the aquifer, namely lateral permeability, anisotropy, specific storage and spe-cific yield. The results indicated that the model response of hydraulic heads in the aquifer was mainly sensitive to variations in lateral permeabil-ity and specific yield alone. The simulation model was also applied to analyze data from well pump-ing tests. The particular combination of parameters characterizing the aquifer at the test-site were iden-tified by a parameter adjustment procedure. (Wood-PTT)
W87-04396

WATER-TABLE HEIGHTS AND DISCHARGE RATES WITH ARTESIAN FLOW TO INTER-CEPTOR LAND DRAINS, Rothamsted Experimental Station, Harpenden (England). Dept. of Soils and Plant Nutrition.

Journal of Hydrology JHYDA7, Vol. 87, No. 3/4, p 255-266, October 30, 1986. 13 fig, 11 ref.

Descriptors: *Water table, *Artesian flow, *Drainage ditches, *Mathematical studies, *Groundwater, Ditches, Soil surfaces, Graphical analysis, Mathematical equations, Artesian head.

Water-table heights and discharge rates from paral-lel interceptor ditch drains in soils with artesian

flow from a permeable substratum were analyzed by the method of conformal transformations. Re-sults were given in graphs that show the relationsults were given in graphs that show the relation-ahips between the maximum water-table height and discharge rate in terms of the drain spacing, the depth of the permeable substratum, the artesian head and the hydraulic conductivity of the saturat-ed soil. The results for the water-table height fit the empirical equation: H sub m / h sub a = 1 exp(-1.65 D/(h sub a + d)) where H sub m was the maximum water-table height and h sub a the arte-sian head, both measured relative to the bottom of the ditches that were a beight daybox the recrue san nead, both measured relative to the bottom of the ditches that were a height d above the permea-ble substratum, and D was the half-spacing of the ditches. (Author's abstract) W87-04398

MODIFIED STRONGLY IMPLICIT PROCE-DURE FOR GROUNDWATER FLOW ANALY-

n Inst. of Science, Bangalore. Dept. of Civil Engineering. M. S. Mohan Kumar, K. Sridharan, and N. S.

Lakshmana Rao. Journal of Hydrology JHYDA7, Vol. 87, No. 3/4, p 299-314, October 30, 1986. 12 fig. 6 ref.

Descriptors: *MSIP, *Groundwater movement, *Implicit procedure, *Mathematical models, *Modified strongly implicit procedure, *Groundwater flow, *Confined aquifers, *Transmissivity, *Mathematical equations, Computers, Equations, Seepage, Recharge wells, Mathematical analysis, Flow.

A Modified Strongly Implicit Procedure (MSIP) to solve two dimensional groundwater flow problems in non-rectangular regions was presented. At present while using SIP, such problems are solved over a superscribed rectangular computational region with zero transmissivities for nodes outside the region of interest. This leads to wastage in computer storage and time. The MSIP was developed to handle non-rectangular regions directly without such dummy nodes. It was found that except for four types of boundary nodes, the same equations as in the normal SIP were applicable. The relationships for the special types of boundary nodes for row computations were presented. The In e retationships for the special types of boundary nodes for row computations were presented. The method was tested on two test problems and compared with other finite difference methods, and MSIP was found to be the best. The MSIP will be particularly advantageous in regions with non-rectangular boundaries and where a number of parameters have to be stored for each node. (Author's abstract)

VOLUMETRIC APPROACH TO NON-DARCY

FLOW IN CONFINED AQUIFERS, Technical Univ. of Istanbul (Turkey). Dept. of Hydraulics and Water Power.

Journal of Hydrology JHYDA7, Vol. 87, No. 3/4, p 337-350, October 30, 1986. 6 fig, 1 tab, 31 ref,

Descriptors: *Nondarcian flow, *Confined aquifers, *Groundwater movement, *Darcys law, *Mathematical studies, *Forchheimer flow law, *Pumping tests, Mathematical equations, Mathematical analysis, Continuity equations, Laminar flow, Turbulent flow, *Papadopulos curve, Cooper curve, Drawdown, Nova Scotia.

Analytical expressions for type curves were derived for non-Darcian groundwater flows which occur naturally in coarse grained or fractured media. The basis of the derivation was the continuity equation coupled with the Forchheimer flow law which has laminar and turbulent flow components. Combination of these two equations by the concept of depression cone volume led to the desired solution. Sets of type curves were obtained for different storage coefficients and Forchheimer flow condition. It was observed that in the case of non-linear flow the initial portions of the type curves were straight lines on a double logarithmic paper. Irrespective of the turbulence factor values, these portions corresponded to the Papadopulos and Cooper type curves. The latter portions had

curvature that depended on the turbulence factor and were invariably above the Papadopulos and Cooper curves which present Darcian flow. For the same discharge and the storage coefficient, the the same discharge and the storage coefficient, the non-Darcian flow caused greater drawdowns than the Darcian flow. The pumping test data used was taken from work done by Gale in 1977 on the fractured and coarse grained crystalline and metamorphic rocks of Nova Scotia, Canada. (Wood-DTT). PTT) W87-04403

MODELLING FRESH WATER INJECTION INTO A PARTIALLY SALINE PARTIALLY FRESH (PASPAF) AQUIFER, Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
H. Rubin, and A. Pistner.
Journal of Hydrology JHYDA7, Vol. 87, No. 3/4, p 351-378, October 30, 1986. 6 fig. 1 tab, 22 ref, append.

Descriptors: *Disposal wells, *Injection wells, *Infiltration, *Groundwater, *Fresh water injection, *Saline water, *Aquifers, *Mathematical models, *Saline-freshwater interfaces, *Recharge wells, Mathematical equations, Mathematical studies, Downconing, Numerical simulations, Transition

A study of physical phenomena typical to injection of fresh water, like treated effluents, into an aquifer whose deep layers are saturated with saline water, and whose upper layers are saturated with fresh water was presented. The study concerned infiltration by recharge wells as well as over an infiltrating area. It also presented the development of the appropriate numerical model and various numerical simulations demonstrating the applicability of ang ates. It also presented the development of the appropriate numerical model and various numerical simulations demonstrating the applicability of the model and representing the possible physical phenomena associated with the fresh water injection. The numerical model was able to simulate the downconing process and the formation of the transition zone in the aquifer. The numerical experiments with the model indicated that the fresh water injection may lead to degradation of the groundwater quality mainly around the injection site. Quantitative calculations of such an effect and the suggestion that practical methods controlling this effect should be developed were given. The authors concluded that the design of fresh water injection systems should consider the adoption of salinization control methods. (Wood-PTT)

GROUNDWATER LOWERING IN THE FOUN-DATION PIT OF THE KAISIADORYS PUMPED-STORAGE STATION, For primary bibliographic entry see Field 8A. W87-04414

SOIL AND GROUNDWATER SALINITY ALONG DRAINAGE DITCHES IN EASTERN NORTH DAKOTA, North Dakota State Univ., Fargo. Dept. of Soil For primary bibliographic entry see Field 4C. W87-04445 Science.

APPROACH TO THE MATHEMATICAL EX-PRESSION OF RECESSION CURVES, Hydrological Research Inst., Pretoria (South For primary bibliographic entry see Field 2E. W87-04485

MODELLING OF GROUND-WATER LEVELS IN THE GROOTFONTEIN COMPARTMENT IN WESTERN TRANSVAAL (DIE MODELLER-ING VAN GRONDWATERVLAKKE IN DIE GROOTFONTEINKOMPARTEMENT IN WES-

GROUTFONTEINKOMPARTEMENT IN WESTRANSVAAL),
Orange Free State Univ., Bloemfontein (South Africa). Inst. vir Grondwaterstudies.
G. J. van Tonder, H. J. van Rensburg, J. F. Botha, and D. B. Bredenkamp.
Water S. A. WASADV, Vol. 12, No. 3, p 151-160, July 1986. 11 fig, 2 tab, 21 ref.

Group 2F-Groundwater

Descriptors: *Flow models, *Aquifers, *Ground-water level, *Model studies, *Grootfontein, *Finite element method, *South Africa, Water supply desent Prediction Water demi

The Grootfontein compartment is situated near Mafikeng in the Western Transvaal and supplies water to the townships of Mafikeng and Mmahatho. It also yields appreciable amounts of ground water for irrigation purposes. Ground water abstraction in 1994 totalled 15 million cut ft. By utilizing the available information and finite element method, a good flow model for the aquifer was constructed. By using this model it was possible to predict the behavior of the Grootfontein aquifer successfully. It is concluded that the Grootfontein compartment has a life span of about 11 years, given the present demand. It is therefore recommended that the aquifer be utilized as an auxiliary water supply in the future. (Author's abstract) abstract)

CONTRIBUTION TO THE STUDY OF TEMPO-RAL VARIATIONS IN THE CHEMISTRY OF SPRING WATER IN KARSTIFIED CARBON-

Agriculture and Water Resources Research Centre, Baghdad (Irag). S. B. Jawad, and K. A. Hussien.

Hydrological Sciences Journal HSJODN, Vol. 31, No. 4, p 529-541, December 1986. 9 fig, 2 tab, 11

Descriptors: *Karst, *Temporal distribution, *Chemical analysis, *Springs, *Groundwater movement, *Spring water, *Aquifers, Chemical properties, Water properties, Iraq, Seasonal varia-

The temporal variations of spring water chemistry are used to support observations on the nature of ground water circulation inside a karstified carbonate terrain. Variations in some hydrochemical properties such as the Ca(++) to Mg(++) ratio, the hardness, the electric conductivity, the CO2 partial pressure, and the calcite and dolomite saturation ratios are used to give indications with regard to the nature of the carbonate rock, the groundwater residence time, and the mode of water circulation inside the karstic system. The seasonal variations of these properties during four years of monitoring were determined for six adjacent springs in a karstified carbonate terrain inorthwest Iraq. The carbonate terrain inorthwest Iraq. The carbonate terrain is known to be mostly limestone with some dolomitic limestone beds, has given an average value of 3.3 for the Ca(++) to Mg(++) ratio. The magnesium and calcium hardness has high values (341-368 ppm) with a coefficient that exceeds 11 per cent. The partial pressure of CO2 has a minimum of 10 to the minus 1.8 power bar. The values of the calcite and dolomite saturation indices fluctuate about saturation levels despite the presence of an appreciable concentration of NaCI. These results, when The temporal variations of spring water chemistry and dolomite saturation indices fluctuate about saturation levels despite the presence of an appre-ciable concentration of NaCl. These results, when combined with other analyses and observations related to the flowrate characteristics of the springs, have revealed that the six springs are fed by a common diffuse type karstic system with a rather high but acceptable coefficient of variation of hardness. (Author's abstract)

APPLICATION OF DRAINAGE THEORY IN THE FIELD,

Rothamsted Experimental Station, Harpenden (England). For primar W87-04570 ary bibliographic entry see Field 2G.

GROUT AND SLURRY WALLS FOR HAZ-WASTE CONTAINMENT: THE DOWN SIDE, California Univ., Berkeley. Dept. of Mechanical Engineering. For primary bibliographic entry see Field 5G. W87-04582

MODELING OF SOLUTE TRANSPORT IN AGGREGATED/FRACTURED MEDIA INCLUDING DIFFUSION INTO THE BULK MATRIX, Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5B. W87-44555

DUAL-GAMMA ATTENTUATION FOR THE DETERMINATION OF POROUS MEDIUM SATURATION WITH RESPECT TO THREE FLUIDS.

Princeton Univ., NJ. Water Resources Prop For primary bibliographic entry see Field 5A. W87-04755

CONTAMINANT TRANSPORT THROUGH A FRACTURED POROUS ROCK: IMPACT OF THE INLET BOUNDARY CONDITION ON THE CONCENTRATION PROFILE IN A ROCK

Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering. For primary bibliographic entry see Field 5B. W87-04762.

STREAMLINE ROUTING THROUGH FRAC-TURE JUNCTIONS,
Idaho National Engineering Lab., Idaho Falls.
L. C. Hull, and K. N. Koslow.

L. C. Hull, and K. N. Koslow. Water Resources Research WRERAQ, Vol. 22, No. 12, p 1731-1734, November 1986. 5 fig. 3 tab, 7 ref. DOE Contract DE-AC07-76IDO1570.

scriptors: *Fracture junctions, *Solute trans-t, *Path of pollutants, *Groundwater move-nt, *Geologic fractures, Streamline routing, minar flow, Mixing, Solutes, Transport, Plumes.

Laboratory experiments in a single, four-branch fracture junction were conducted to determine criteria for routing streamlines through fracture juncions. Under laminar flow conditions, no evidence of complete mixing was observed. For continuous junctions, only one criterion is needed to correctly route streamlines: streamlines cannot cross. For route streamlines: streamlines cannot cross. For discontinuous junctions, a second criterion is necessary: flow along adjacent streamlines must be in the same direction. Based on these two criteria, a unique distribution of streamlines can be obtained for any configuration of multiple fractures meeting at a junction. (Rochester-PTT)

HYDROLOGY OF ALLUVIAL STREAM CHANNELS IN SOUTHERN COASTAL PLAIN WATERSHEDS, Georgia Univ., Athens. Dept. of Agricultural En-For primary bibliographic entry see Field 2E. W87-04924

EVAPORATION AND NON-TILE SEEPAGE DURING WATER TABLE DRAWDOWN, Agricultural Research Service, Temple, TX. For primary bibliographic entry see Field 4B. W87-04925

NONLINEAR-REGRESSION GROUNDWATER FLOW MODELING OF A DEEP REGIONAL AQUIFER SYSTEM, Geological Survey, Lakewood, CO. Water Re-sources Div.

R. L. Cooley, L. F. Konikow, and R. L. Naff. Water Resources Research WRERAQ, Vol. 22, No. 13, p 1759-1778, December 1986. 11 fig. 5 tab,

Descriptors: *Groundwater movement, *Model studies, *Aquifers, *Mathematical models, Regression analysis, Boundary conditions, Great Plains, Madison aquifer, Permeability, Springs, Leakage, Hydraulic head, Groundwater, Flow, Model test-

Groundwater is most commonly developed as a source of water supply because it represents a

reliable, economical, and local source of water that usually is of good quality. A nonlinear regression groundwater flow model, based on a Galerkin finite-element discretization, was used to analyze steady state two-dimensional groundwater flow in the areally extensive Madison aquifer in a 75,000 aq mi area of the Northern Great Plains. Regression parameters estimated include intrinsic permeabilities of the main aquifer and sengrate lineament. parameters estimated include intrinsic permeabili-ties of the main aquifer and separate lineament zones, discharges from eight major springs sur-rounding the Black Hills, and specified heads on the model boundaries. Aquifer thickness and tem-perature variations were included as specified functions. The regression model was applied using sequential F testing so that the fewest number and simplest zonation of intrinsic permeabilities, compersaure variations were included as specified functions. The regression model was applied using sequential F testing so that the fewest number and simplest zonation of intrinsic permeabilities, combined with the simplest overall model, were evaluated initially; additional complexities (such as subdivisions of zones and variations in temperature and thickness) were added in stages to evaluate the subsequent degree of improvement in the model results. It was found that only the eight major springs, a single main aquifer intrinsic permeability, two separate lineament intrinsic permeability, two separate lineament intrinsic permeability, two separate lineament intrinsic permeabilities of much smaller values, and temperature variations are warranted by the observed data (hydraulic heads and prior inclusion in a model that attempts to explain neads and prior information on some parameters) for inclusion in a model that attempts to explain significant controls on groundwater flow. Addition of thickness variations did not significantly improve model results; however, thickness variations were included in the final model because they are fairly well defined. Effects on the observed head were included in the final model because they are fairly well defined. Effects on the observed head distribution from other features, such as vertical leakage and regional variations in intrinsic perme-ability, apparently were overshadowed by meas-urement errors in the observed heads. Estimates of the parameters correspond well to estimates ob-tained from other independent sources. (Alexander-PTT) W87-04942

SOLUTE TRANSPORT PARALLEL TO AN INTERFACE SEPARATING TWO DIFFERENT

INLERFACE SEPARATING TWO DIFFERENT POROUS MATERIALS, Technische Hogeschool Delft (Netherlands). On-derafdeling der Wiskunde en Informatica. For primary bibliographic entry see Field 5B. W87-04948

THREE-DIMENSIONAL FINITE-ELEMENT MODEL FOR SIMULATING WATER FLOW IN VARIABLY SATURATED POROUS MEDIA, GeoTrans, Inc., Herndon, VA. For primary bibliographic entry see Field 2G. W87-04944

MODEL TO EVALUATE THE TRANSIENT HYDRAULIC RESPONSE OF THREE-DIMEN-SIONAL SPARSELY FRACTURED ROCK MASSES, Pennsylvania State Univ., University Park. Dept. of Mineral Engineering.
For primary bibliographic entry see Field 5B. W87-04985.

GROUNDWATER CONTAMINATION FROM AN INACTIVE URANIUM MILL TAILINGS PILE: 2. APPLICATION OF A DYNAMIC MIXING MODEL, California Univ., Berkeley. Lawrence Berkeley Lab. Lab For primary bibliographic entry see Field 5B. W87-04946

GREEN AND AMPT ANALYSES FOR RISING WATER TABLE AND INTERMITTENT SURFACE FLUX CONDITIONS, New South Wales Univ., Kensington (Australia). School of Civil Engineering.
K. K. Watson, and S. A. Awadalla.
Water Resources Research WRERAQ, Vol. 22, No. 13, p 1835-1843, December 1986. 13 fig. 17 ref.

Descriptors: *Mathematical equations, *Ground-water movement, *Water table fluctuations, *Mathematical models, *Numerical analysis, Porous media, Prediction, Computers, Computer

programs, Wetting, Hysteresis, Simulation analysis, Model studies.

Equations developed for a Green and Ampt type analysis for moving water table conditions in an initially saturated homogeneous profile of porous material and used previously in a falling water table study were applied to a falling-rising water table sequence in a sand. The ability of the equations to be used in a system involving a directional change in water table movement relates to the inclusion in the equations of a term describing the initial saturated depth applicable to each new stage of the analysis. The predictive capability of the Green and Ampt approach for such a system was tested by comparing the results with those obtained from a computer-based numerical analysis. tested by comparing the results with those obtained from a computer-based numerical analysis. The relevant subroutine in the computer program required certain restructuring to accommodate the rising water table component. An interpolative hysteresis model was used to describe the accompanying wetting process with the material in question wetting up along primary wetting scanning curves. In comparison with the complexity of the real system during rewetting, the simplicity of the Green and Ampt approach is very marked. Notwithstanding this, it was found that reasonable correspondence occurs, although care is necessary in specifying an appropriate value, applicable to withstanding this, it was found that reasonable correspondence occurs, although care is necessary in specifying an appropriate value, applicable to the wetting process, for the characteristic pressure head at the sharp front. The Green and Ampt approach was also extended to include a falling water table system where an applied surface flux of constant magnitude is discontinued during the gravity drainage process. The analysis can be adapted to such intermittent inflow; comparisons with a numerical simulation indicated that satisfactory accuracy is achievable. (Author's abstract) W87-04947

EQUIVALENT CONTINUUM MODEL FOR COUPLED STRESS AND FLUID FLOW ANALYSIS IN JOINTED ROCK MASSES, Saitama Univ. (Japan). Dept. of Foundation Engi-

meering. M. Oda.

Water Resources Research WRERAQ, Vol. 22, No. 13, p 1845-1856, December 1986. 13 fig, 2 tab,

Descriptors: *Groundwater movement, *Mathematical models, *Fluid flow, *Rocks, *Mathematical equations, *Porous media, *Rock properties, Permeability, Springs, Seepage, Anisotropy, Field tests, Model studies, Geologic fractures.

tests, Model studies, Geologic fractures.

In the recent topics of rock hydraulics, much attention is focused on groundwater flow through various geological discontinuities to solve some problems concerning geothermal energy, earthquakes, and deep underground burial of high-level nuclear waste. Geological discontinuities such as faults and joints are of widespread occurrence in rock masses. To treat these discontinuities such as faults and joints are of widespread occurrence in rock masses. To treat these discontinuities in the numerical analyses of rock masses, the so-called joint element has been developed. To provide a set of governing equations for solving the coupled stress and fluid flow, a rock mass, which commonly contains a large number of geological discontinuities, is treated as an anisotropic, elastic porous medium with the corresponding elastic compliance and permeability tensors, hydromechanical equivalents, with the special emphasis on the permeability tensor, are formulated on the assumption that any crack can be replaced by a set of parallel planar plates connected by two springs. Two-dimensional numerical analyses on seepage flow networks support the validity of the permeability tensor. Some field evidence is analyzed to examine the applicability of the present model for the practical purpose of rock hydraulics. (Alexander-PTT)

SIMULATION OF CONTAMINANT PLUMES SIMULATION OF CUMMINANT PLUMES WITH LARGE DISPERSIVE CONTRAST: EVALUATION OF ALTERNATING DIRECTION GALERKIN MODELS, Waterloo Univ. (Ontario). Dept. of Earth Sciences. For primary bibliographic entry see Field 5B. W87-04949

PREDICTING MASS TRANSPORT IN DISCRETE FRACTURE NETWORKS WITH THE AID OF GEOMETRICAL FIELD DATA, Royal Inst. of Tech., Stockholm (Sweden). Dept. of Hydraulics Engineering. For primary bibliographic entry see Field 5B. W87-04956

SECOND-ORDER APPROACH FOR THE MODELING OF DISPERSIVE TRANSPORT IN POROUS MEDIA: 3. APPLICATION TO TWO POROUS MEDIA PROBLEMS, Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.

For primary bibliographic entry see Field 5B. W87-04958

TRANSPORT OF DISSOLVED HYDROCAR-BONS INFLUENCED BY OXYGEN-LIMITED BIODEGRADATION: 1. THEORETICAL DE-

VELOPMENT, North Carolina State Univ. at Raleigh. For primary bibliographic entry see Field 5B. W87-04959

TRANSPORT OF DISSOLVED HYDROCAR-BONS INFLUENCED BY OXYGEN-LIMITED BIODEGRADATION: 2. FIELD APPLICATION, North Carolina State Univ. at Raleigh. For primary bibliographic entry see Field 5B. W87-04960

CHLORINE 36 DATING OF VERY OLD GROUNDWATER: 1. THE GREAT ARTESIAN BASIN, AUSTRALIA, Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
H. W. Bentley, F. M. Phillips, S. N. Davis, M. A. Habermehl, and P. L. Airey.
Water Resources Research WRERAQ, Vol. 22, No. 13, p 1991-2001, December 1986. 8 fig, 1 tab, 22 ref. NSF Grants INT-8111034 and PHY-82-

Descriptors: *Chlorine-36, *Groundwater dating, *Artesian Basin, *Geochemistry, *Water analysis, *Isotope studies, Radioactive half-life, Simulation, Hydrodynamics, Groundwater, Spectral analysis.

The age of groundwater can be defined as the length of time the water has been isolated from the atmosphere. Even though all samples are affected to some degree by mixing the concept of an 'average' groundwater age is a useful one. Chlorine 36 has many advantages as a dating tool for very old groundwater. These advantages include a suitable half-life (301000 years), simple geochemistry, conservative behavior in groundwater, and a general absence of subsurface sources at levels comparable to the atmospheric input. Recent advances in tandem accelerator mass spectrometry have permitted the analysis of 36Cl at the low abundance expected following residence in the subsurface for 1000000 years or more. In order to test the suitability of 36Cl for dating very old groundwater, the 36Cl/Cl ratios of 26 groundwater samples from the Great Artesian Basin of Australia were measured. Groundwater ages calculated from the 36Cl data compare favorably with ages computed independently from hydrodynamic simulations. (See also W87-04961)

CHLORINE 36 DATING OF VERY OLD GROUNDWATER: 2. MILK RIVER AQUIFER, ALBERTA, CANADA, New Mexico Inst. of Mining and Technology, Socorro. Dept. of Geoscience. F. M. Phillips, H. W. Bentley, S. N. Davis, D. Elmore, and G. B. Swanick.
Water Resources Research WRERAQ, Vol. 22, No. 13, p. 2003-2016, December 1986. 13 fig., 2 tab, 17 ref. NRC Contract NRC-04-78-272; Office of Nuclear Waste Isolation Contract E51L-04900; NSF Grant PHY-82-40321.

Descriptora: *Chlorine-36, *Groundwater dating, *Milk River aquifer, *Isotope studies, *Water analysis, Groundwater, Geochemistry, Sandstone, Aquifers, Leakage, Shale, Discharge, Connate water.

water.

Chlorine 36 groundwater dating was applied to the Milk River aquifer in southern Alberta, Canada, which consists of sandstone interbedded between thick shale units. The groundwater is confined and discharges by both upward and downward leakage through the shales. The concentration of CI(-) increase by about 2 orders of magnitude downgradient through the aquifer. This CI(-) increase complicates 36Cl dating of the system. Climatic changes, flushing of connate water, introduction of CI(-) from older water below the aquifer, and ion filtration have been proposed as possible explanations for the increase. The 36Cl data show a consistent decrease of the 36Cl/Cl ratio downgradient, but an increase in the 36Cl concentration downgradient in certain parts of the aquifer. Dates calculated from the 36Cl/Cl ratio show a reasonable distribution in light of the hydraulic controls on the system, whereas dates calculated from the 36Cl concentration give negative ages. This suggests that ion filtration is responsible for the CI(-) increase and that the 36Cl/Cl dates are to be preferred. Water ages are estimated to be more than 2 million yr near the distal end of the aquifer. (See also W87-04961) (Alexander-PTT)

NATURAL GRADIENT EXPERIMENT ON SOLUTE TRANSPORT IN A SAND AQUIFER: 1. APPROACH AND OVERVIEW OF PLUME MOVEMENT, Stanford Univ., CA. Dept. of Civil Engineering. For primary bibliographic entry see Field 5B. W87-04963

NATURAL GRADIENT EXPERIMENT ON SOLUTE TRANSPORT IN A SAND AQUIFER: 2. SPATIAL MOMENTS AND THE ADVECTION AND DISPERSION OF NONREACTIVE Stanford Univ., CA. Dept. of Civil Engineering. For primary bibliographic entry see Field 5B. W87-04964

NATURAL GRADIENT EXPERIMENT ON SOLUTE TRANSPORT IN A SAND AQUIFER: 3. RETARDATION ESTIMATES AND MASS

BALANCES FOR ORGANIC SOLUTES, Stanford Univ., CA. Dept. of Civil Engine For primary bibliographic entry see Field 5B. W87-04965

NATURAL, GRADIENT EXPERIMENT ON SOLUTE TRANSPORT IN A SAND AQUIFER: 4. SORPTION OF ORGANIC SOLUTES AND ITS INFLUENCE ON MOBILITY, Stanford Univ., CA. Dept. of Civil Engineering. For primary bibliographic entry see Field 5B. W87-0496

NATURAL GRADIENT EXPERIMENT ON SOLUTE TRANSPORT IN A SAND AQUIFER: SPATIAL VARIABILITY OF HYDRAULIC CONDUCTIVITY AND ITS ROLE IN THE DIS-PERSION PROCESS, Waterloo Univ. (Ontario). Dept. of Earth Sciences. For primary bibliographic entry see Field 5B. W87-04967

GEOPHYSICAL MAPPING OF A BURIED BASALT/SEDIMENTARY INTERFACE, EAST-ERN SUDAN, Kuwait Univ., Safat. Dept. of Geology.

H. O. Ali. Ground Water GRWAAP, Vol. 25, No. 1, p 14-20, nuary-February 1987. 10 fig, 10 ref.

Descriptors: "Geophysical mapping, "Aquifers, "Basalt-sedimentary interfaces, "Sudan, "Groundwater yield, "Gravity reduction method, "El-Shawak, Basins, Sediments, Basalt, Sandstone, Topography, Geohydrology.

Group 2F-Groundwater

The El-Shawak area in the Kassala province of eastern Sudan is a flat region of about 600 aq km (232 aq mi) in area assigned for resettlement of the refugues in the Sudan. The area lies within a large synclinal basin known as the Gedaref Basin, composed principally of clastic sediments of the Nubian Sandstone Formation which are overlain by sheets of basalt and dolerite and underlain by a metamorphic Basement Complex. As a part of a hydrogeological research project in the area, gravity and seismic refraction techniques were combined to locate the extent of the basaltic flow and to determine the thicknesses of the sedimentary formations. The results of these studies show that the topography of the Basement Complex is undusting and characterized by two troughs separated by subsurface ridges. The thicknesses of the Nubian Formation sediments range from 50 m (164 ft) to greater than 250 m (820 ft). Although the thicknesses of the Nubian Formation are favorable for groundwater occurrence, the yield is very limitate and the contractive tensions in the contractive tensions in the contractive tensions. thicknesses of the Nubian Formation are favorable for groundwater occurrence, the yield is very lim-ited because the sediment succession is composed largely of compact mudstone. The application of the gravity method in the El-Shawak area has shown that a polynomial trend-surface fit can be used to separate the regional and the residual com-ponents to reflect local geological features. (Alex-neds PUTS)

GASEOUS BEHAVIOR OF TCE OVERLYING A CONTAMINATED AQUIFER, For primary bibliographic entry see Field 5B. W87-05064

CHARACTERIZATION OF FRACTURE PER-MEABILITY WITH HIGH-RESOLUTION VER-TICAL FLOW MEASUREMENTS DURING BOREHOLE PUMPING, Geological Survey, Denver, CO. Borehole Geo-

Physics Project.
For primary bibliographic entry see Field 4B.
W87-05065

AIRBORNE GEOPHYSICAL EXPLORATION FOR GROUND WATER, Peterson, Grant and Watson Ltd., Toronto (Ontar-

io).

For primary bibliographic entry see Field 7B. W87-05066

GENERATION OF GROUND-WATER AGE DISTRIBUTIONS,

Nevada Univ. System, Reno. Water Resources M. E. Can

Ground Water GRWAAP, Vol. 25, No. 1, p 51-58, January-February 1987. 8 fig, 3 tab, 12 ref.

Descriptors: *Groundwater dating, *Tracers, *Mathematical models, *Isotope studies, *Carbon-14, *Groundwater movement, Reservoirs, Aquifers, Geohydrology, Paleogeohydrology, Tucson Basin, Groundwater, Flow, Dating, Waste

The dating of ground water with carbon-14 (half-life = 5,730 years) is a useful tool for obtaining estimates of ground-water ages and residence times. Discrete-state compartment (DSC) models and their associated age distribution functions permit the quantitative interpretation of environmental radioiaotope data such as carbon-14 ground-water decay ages. These mixing-cell models offer a means for constructing ground-water flow models that can be used to relate decay ages to ground-water mean ages. In addition, DSC models can also generate the entire distribution ages in various subregions of a ground-water resermodels can also generate the entire distribution ages in various subregions of a ground-water reservoir. A preexisting DSC model of a portion of the Tucson Basin alluvial aquifer is used as an example. Ground-water mean ages in this aquifer range from 100 to almost 15,000 years old, with the oldest waters about 40,000 years old, with the oldest waters about 40,000 years old, when the ground-water ages are not normally distributed, means and medians are not equivalent. The results indicate that care must be used in interpreting both groundwater radioisotope decay ages as well as mean water radioisotope decay ages as well as mean ground-water ages and that knowledge of the

entire age distribution is preferable. Age distribu-tions are especially useful in hydrogeologic studies in which mixing is important, such as selections of hazardous waste disposal sites, and may find use in placohydrogeologic investigations. (Alexanderplacohydro PTT) W87-05067

MODELING OF TCE CONTAMINATION AND RECOVERY IN A SHALLOW SAND AQUIFER, McClelland Engineers, Inc., Houston, TX. For primary bibliographic entry see Field 5B.

INNOVATIVE MEANS OF DEALING WITH POTENTIAL SOURCES OF GROUND WATER CONTAMINATION.

Well Association, Worthington, OH.

OH.

Proceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. 528 p. EPA Contract No. CR-811504-

Descriptors: *Groundwater quality, *Groundwater pollution, *Groundwater management, *Water pollution sources, *Path of pollutants, Underground storage, Groundwater mining, Injection wells, Aquifers, Water pollution control, Landfills, Geohydrology.

The theme of this conference was 'developing and implementing innovative means of dealing with potential sources of groundwater contamination.' Among the potential sources of contamination addressed at the meeting were: underground storage tanks; mining and mine wastes; agricultural chemicals and land application practices; injection wells; abandoned wells; and hazardous and non-hazardous wastes in landfills and impoundments. Government officials, consulting engineers, geologists and hydrologists, planners industry representatives, academicians and others met to discuss these and other topics and to share their experiences in these areas. These proceedings are a compilation of the papers presented by the symposium speakers. (See W87-05072 through W87-05099) (Author's abstract) The theme of this conference was 'developing and stract) W87-05071

DEVELOPMENT AND IMPLEMENTATION OF REGULATIONS TO CONTROL UNDER-GROUND FUEL STORAGE TANKS ON CAPE

COD, IEP, Inc., Barnstable, MA. For primary bibliographic entry see Field 5G. W87-05072

ELECTRICAL LEAK DETECTION SYSTEMS FOR UNDERGROUND STORED CHEMICALS AND FUELS,
Residuals Management Technology, Inc., Madison, WI.

For primary bibliographic entry see Field 5G. W87-05073

MANAGEMENT OF GASOLINE LEAKS - A

POSITIVE OUTLOOK,
Los Angeles City Dept. of Water and Power, CA.
For primary bibliographic entry see Field 5G.

EPICHLOROHYDRIN IN SECONDARY CON-TAINMENT SYSTEMS,

Carlisle SynTec Systems, PA.
For primary bibliographic entry see Field 5G.
W87-05075

PRACTICAL DISPOSAL WELL DESIGN FOR THE PREVENTION OF GROUND WATER CONTAMINATION,

Davis (Ken E.) Associates, Houston, TX. For primary bibliographic entry see Field 5G. W87-05077

EVALUATION OF CONFINING LAYERS FOR CONTAINMENT WASTEWATER,
Missouri Univ.-Rolla. Dept. of Geological Engi-

neering.
For primary bibliographic entry see Field 5E.
W87-05078

EFFECTS OF URANIUM MILL TAILINGS ON GROUND WATER QUALITY: A HISTORICAL PERSPECTIVE, Nuclear Regulatory Commission, Washington, DC. Div. of Waste Management. For primary bibliographic entry see Field 5C. W87-05081

RAPID ASSESSMENT METHODOLOGY FOR LEACHING OF AGRICULTURAL CHEMI-

Anderson-Nichols and Co., Inc., Palo Alto, CA. For primary bibliographic entry see Field 5B. W87-05085

VEGETATION MANAGEMENT: A SOLUTION TO SHALLOW GROUND WATER CONTAMINATION IN NORTH-CENTRAL MONTANA, Triangle Conservation District, Conrad, MT.
For primary bibliographic entry see Field 5G.
W87-05086

BANDONED WELLS - HOW TO FIND National Water Well Association, Worthington,

OH. For primary bibliographic entry see Field 5B. W87-05087

SUMMARY AND COMPARISONS OF THREE TECHNOLOGIES FOR LOCATING ABANDONED WELLS IN CENTRAL OKLAHOMA, Environmental Photographic Interpretation Center, Warrenton, VA.
For primary bibliographic entry see Field 5B.
W87-05088

ABANDONED WATER WELLS IN SOUTH-EASTERN MINNESOTA, Minnesota Dept. of Natural Resources, St. Paul. Div. of Waters. For primary bibliographic entry see Field 5B. W87-05089

CONTRARY WASTE SITE CHARACTERISTICS – GOOD IS BAD, BAD IS GOOD, For primary bibliographic entry see Field 5E. W87-05091

TRANSPORT OF ORGANIC CONTAMINANTS IN GROUND WATER, New Mexico Inst. of Mining and Technology, Socorro. For primary bibliographic entry see Field 5B. W87-05092

UNCERTAINTY IN GROUND WATER TRANS-PORT MODELING, Oklahoma State Univ., Stillwater. For primary bibliographic entry see Field 5B. W87-05093

EVALUATION OF THE PERFORMANCE OF ZONE OF SATURATION LANDFILLS IN WIS-

CONSIN, Wisconsin Dept. of Natural Resources, Madison. Bureau of Solid Waste Management. For primary bibliographic entry see Field 5B. W87-05094

VERTICAL MOVEMENT OF GROUND WATER UNDER A LANDFILL, ANCHORAGE, ALASKA, Geological Survey, Anchorage, AK. Water Re-

Groundwater-Group 2F

sources Div.

G. L. Nelson G. L. Nelson.
In: Innovative Means of Dealing with Potential
Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water
Quality Symposium, September 26-28, 1984, Las
Vegas, Nevada. National Water Well Association,
500 W. Wilson Bridge Road, Worthington, Ohio,
1984. p 453-477, 9 fig. 4 ref.

Descriptors: "Vertical flow, "Groundwater move-ment, "Path of pollutants, "Landfills, "Anchorage, "Alaska, Performance evaluation, Fate of pollut-ants, Groundwater pollution, Pressure head, Per-meability coefficient, Darcy's Law, Hantush's Theory, Leaky aquifers, Extensometers.

Theory, Leaky aquifers, Extensometers.

A thorough review of existing groundwater information may, in some cases, be adequate to estimate rates of migration of pollutants. Analysis of data from well-performance tests and from hydrologic-data stations near a landfill in Anchorage. Alaska, indicates that pollutants migrating downward toward a confined aquifer that supplies water to three municipal wells near the landfill do not pose an imminent threat to the water supply. The hydrostatic relationship, total head = gravity head + pore pressure, was used to estimate that gradients through two confining units are 1.6 and 0.033. An analysis of extensometer data for elastic compaction of sediments in 0.000023 reciprocal feet (0.0000754 reciprocal meters). An analysis of several well-performance tests using the extensometer results and Hantush's leaky-aquifer theory indicates that vertical hydraulic conductivities of two confining units are 0.01 and 0.02 ft/day (0.003 and 0.0006 m/day). The values of vertical hydraulic conductivity and vertical gradients were used with Darcy's law and theoretical solute transport curves to estimate that incipient entry of pollutants to the aquifer may occur about 80 years after leachate began migrating downward. Breakthrough of 'full-strength' leachate probably will not occur prior to 250 years after downward migration began. (See also W87-05071) (Author's abstract)

GROUND WATER QUALITY MANAGEMENT AT A CONCENTRATED WASTE SITE, Henningson, Durham and Richardson, Inc., St. Petersburg, FL. For primary bibliographic entry see Field 5G. W87-35099

RELATION OF GROUNDWATER QUANTITY AND QUALITY. International Association of Hydrological Sci-

ences.

IAHS Publication No. 146. International Association of Hydrological Sciences, Wallingford, England, 1985. Proceedings of a Symposium Held
During the XVIIIth General Assembly of the
International Union of Geodesy and Geophysics,
Hamburg, FR Germany, August 1983. Edited by
F. X. Dunin, G. Matthess, and R. A. Gras. 316 p.

Descriptors: *Groundwater management, *Groundwater quality, *Water supply, *Conferences, Water supply development, Groundwater potential, Groundwater budget, Water used, Water pollution sources, Path of pollutants.

Groundwater is a vital resource in supplying community needs for fresh water. Subsurface sources with reserves exceeding those of other terrestrial forms of stored liquid water, provide a continuity of flow generally of usable quality. These desirable attributes are currently being threatened by human interference to groundwater systems. Improved control of mass transport in both the saturated and unsaturated zones is needed both to arrest and avoid these trends. An understanding of the relationship between the quantity and quality of groundwater flow is important in achieving this control. The impact of human activity on groundwater flow is important in achieving this symposium. Any management strategy needs to account for recharge rate, assessment of which may be facilitated by known relationships between rate of flow and its quality. These considerations Groundwater is a vital resource in supplying com-

provide a basis for subdividing the general theme of the symposium into five discussion topics: (1) effects of quantitative human activities on groundwater quality; (2) influence of hydrological parameters (e.g. permeability, porosity) on direction and extent of transport of chemical pollutants to groundwater; (3) periodic and long-term changes of quantity and quality of groundwater; (4) groundwater quality parameters as indicators of groundwater flow; and (5) methods of quantity/quality studies. The general aim of this forum is twofold: (1) to appraise the extent and nature of groundwater degradation and (2) to assess the scientific understanding of coupled flow in meeting the challenges raised by groundwater systems in decline. These proceedings consisting of 27 papers evenly distributed between the specified topics, offer material to meet both aims. (See W87-0510) thru W87-05127) (Lantz-PTT)

RESPONSES OF HYDROLOGICAL SYSTEMS TO CHANGES IN WATER QUANTITY AND QUALITY, Institute for Soil Fertility, Groningen (Nether-lands).

For primary bibliographic entry see Field 4B. W87-05101

GROUNDWATER CHANGES IN THE URBAN AREA OF WROCLAW IN THE PERIOD 1874-

1974,
Akademia Rolnicza, Wrocław (Poland). Inst. of
Hydro- and Geotechnics.
J. Kowalski, and Z. Janiak.
IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the
XVIIIth General Assembly of the International
Union of Geodesy and Geophysics, Hamburg, FR
Germany, August, 1983. IAHS Publication No.
146. p 45-56, 7 fig, 3 tab, 10 ref.

Descriptors: *Groundwater quality, *Wroclaw, *Poland, *Water pollution sources, *Urban areas, Groundwater level, Mathematical models, Aquifers, Oder River, Chemical analysis, Sulfates, Bicarbonates, Groundwater recharge, Geohydro-

A general rise in the level of the River Oder in the vicinity of Wroclaw has resulted in an increase in the mean groundwater level. On the basis of a mathematical model it was calculated that at maximum levels the aquifers were replenished by infiltration of rainwater at a rate of 0.027 mm/h in built-up areas and 0.058 mm/h in open areas. The aquifer in the Oder Valley is drained by the sewage system at a rate of 2.80 L/s/sq km. The chemical composition of groundwaters within the built-up area differed from the natural composition exceeding 500 mg/L was due to a high content of sulfates and bicarbonates. High sulfate concentrations exceeding 500 mg/L were almost always connected with the presence of war debris, slags and wastes in the topsoil horizon. Variability of sulfate concentration depended on rainfall distribution and hydrogeological conditions and, above all, on the groundwater velocity. (See also W87-05100) (Author's abstract) on the groundwater (Author's abstract) W87-05105

SHAPE AND POSITION OF THE SALT WATER WEDGE IN COASTAL AQUIFERS, Technische Hogeschool Delft (Netherlands). Dept. of Civil Engineering.

J. C. Dam.
IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 59-75, 11 fig, 2 tab, 3 ref.

Descriptors: *Saline water intrusion, *Coastal aquifers, *Salt water wedge, *Saline-freshwater interfaces, Confined groundwater, Groundwater, Geohydrology, Graphical analysis, Piezometry.

The shape and position of the interface between fresh and saline groundwater in coastal aquifers is

discussed. It is restricted to the one-dimensional case in steady state. The interface is assumed to be sharp, and the effects of diffusion and dispersion are neglected. Three case studies are included: (a) confined groundwater. The study clearly shows the influence of various geohydrological constants on the shape and position of the salt water wedge. Results are presented in graphs describing the horizontal distance between an observation well and the upper and lower ends of the salt water wedge as a function of the piezometric level of the fresh groundwater observed in that well. The results are useful in predicting the effect of human activities, such as groundwater abstraction, on the length and position of the salt water wedge. (See also W87-05100) (Author's abstract) W87-05106

STUDY OF IMPROVING GROUNDWATER QUALITY BY DITCH DRAINS AND TUBE WELLS, Wuhan Inst. of Hydraulic and Electric Power En-

gineering (China).
For primary bibliographic entry see Field 5G.
W87-05107

STOCHASTIC MODELLING OF SOLUTE TRANSPORT BY GROUNDWATER FLOW: STATE OF THE ART, Tel-Aviv Univ. (Israel). Dept. of Fluid Mechanics and Heat Transfer. For primary bibliographic entry see Field 5B. W87-05108

RANDOM WALK METHOD FOR THE SIMU-LATION OF MACRODISPERSION IN A STRATIFIED AQUIFER.

Rijksinstituut voor Drinkwatervoorziening, Leids-chendam (Netherlands). G. J. M. Uffink.

G. J. M. Uffink. In: Relation of Groundwater Quantity and Qual-ity, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 103-114, 8 fig, 3 tab, 11 ref.

Descriptors: *Random walk method, *Stratifica-tion, *Path of pollutants, *Aquifers, *Simulation analysis, *Macrodispersion, *Groundwater move-ments, Mathematical analysis, Solute transport, Permeability coefficient, Mathematical equations.

A numerical method is proposed for solute transport in two-dimensional horizontal groundwater flow in a stratified aquifer. The convective component of the solute flux is calculated by a Runge-Kutte integration of the motion equations of individual particles. Vertical variations of hydraulic conductivity are taken into account. The dispersive component of the solute flux is simulated by a random walk. The method can be used for uniform as well as for non-uniform flow. For uniform flow an analytical analysis is given. Numerical results for the uniform case are in good agreement with this analytical solution. Several examples are given for different flow problems, including flow towards a pumping well. (See also W87-05100) (Author's abstract)

INFLUENCE OF MICRO- AND MACRO-STRUCTURE OF AQUIFERS ON THE SPREADING OF POLLUTANTS, Vizgazdalkodasi Tudomanyos Kutato Intezet, Bu-Vizga dapest (Hungary).
For primary bibliographic entry see Field 5B.
W87-05110

SIMULATION OF SOLUTE TRANSPORT IN AQUIFERS BY MEANS OF A MATHEMATI-CAL MODEL WITH LITTLE NUMERICAL DIFFUSION (SIMULATION DU TRANSPORT DE POLLUANT DANS LES NAPPES PAR UN MODELE A FAIBLE DIFFUSION NUMERI-QUE), Electricite de France, Paris.

Group 2F-Groundwater

For primary bibliographic entry see Field 5B. W87-05111

TRANSPORT OF POLLUTANTS AND SCALE EFFECTS (TRANSPORT DE POLLUTANTS ET EFFETS D'ECHELLE), Montpellier-2 Univ. (France).

For primary bibliographic entry see Field 5B. W87-05112

HEAT AND MASS TRANSPORT IN SATURAT-ED-UNSATURATED GROUNDWATER FLOW, Technische Hochschule Aschen (Germany, F.R.). Lehrstuhl fuer Wasserbau und Wasserwirtschaft und Inst. fuer Wasserbe W. Pelka.

W. Peila.
In: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146, p 159-166, 3 fig. 12 ref.

Descriptors: *Groundwater movement, *Saturated flow, *Path of pollutants, *Unsaturated flow, *Mass transport, *Heat transfer, Model studies, Groundwater quality, Groundwater management, Groundwater budget, Mathematical models, Groundwater management, Mathematical models,

Groundwater movement.

Because of the increased demand for water in most parts of the world, and the greater intensity of water use, issues of water quality now rank with those of quantity in limiting the development of water resources. A numerical model is presented for calculating transient heat and mass transport in saturated-unsaturated groundwater flow. The model is based on a finite element approach. While the solution of the flow field equation is obtained by a generalized variational approach, the transport equations are solved by means of a weighted residual technique. Salt water intrusion into coastal aquifers, invasion of brackish or polluted groundwater from adjacent aquifers, infiltration from sanitary landfills or polluted surface waters, artificial groundwater recharge, influences of hot or cold water injections from heat pumps or air conditioning, groundwater pollution caused by domestic or industrial accidents and infiltrating fertilizers or posticides are only a part of an incomplete list of possible applications of the model. (See also W87-05104) (Lantz-PTT)

KALMAN FILTER IN GROUNDWATER BASIN SIMULATION - A SENSITIVITY STUDY WITH A SYNTHETIC EXAMPLE, Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Wasserbau und Wasserwirtschaft und Inst. fuer Wasserbau. For primary bibliographic entry see Field 4B. W87-05115

DEGRADATION OF GROUNDWATER RE-SOURCES CAUSED BY INADVERTENT LAND MISUSE, Geological Survey, Reston, VA. For primary bibliographic entry see Field 5C. W87-05116

SALT CONTAMINATION OF A COASTAL

CONFINED AQUIFER,
Mie Univ., Tsu (Japan). Dept. of Geography.
For primary bibliographic entry see Field 5B. W87-05120

GEOCHEMICAL PARAMETERS AS INDICA-TORS FOR GROUNDWATER FLOW,

Waterloo Univ. (Ontario). Dept. of Earth Sciences

P. Fritz.

IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146, p 229-239, 5 fig. 26 ref.

Descriptors: *Geochemistry, *Groundwater move-ment, *Chemical analysis, *Isotopic tracers, *Tracer studies, Aquifers, Canada, Saline water,

Groundwater.

Groundwater flow in the subsurface and discharge into surface systems can be described and monitored with a variety of conservative and nonconservative chemical and isotopic tracers. However, no general rules concerning their applicability can be proposed aithough environmental isotope techniques are particularly well suited to identify and quantify groundwater runoff. However, in deep aquifers where it is normally not possible to apply physical techniques, the use of indirect geochemical/isotope tools is also not without problems. Indeed, their application is not valid where in situ modification of chemistries occurs because of intensive, long term rock-water interactions. This is the case for deep and very saline groundwaters found at depth throughout the Canadian Shield. Where chemical or isotopic variations are observed, they are due to mixing with shallower groundwater, often in response to man's activities. (See also W87-05100) (Author's abstract)

DETERMINATION OF GROUNDWATER MOVEMENT BY MEANS OF ENVIRONMEN-TAL ISOTOPES: STATE OF THE ART,

Gesellschaf fuer Strahlen und Umweltforschung m.b.H., Neuherberg bei Munich (Germany, F.R.). Inst. fuer Radiohydrometrie. H. Moser, and W. Rauert.

H. Moser, and W. Kauert.
In: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 241-257, 10 fig, 2 tab, 22 ref.

Descriptors: *Groundwater movement, *Isotopic tracers, *Chemical analysis, *Soil water, *Tracer studies, Deuterium, Tritium, Oxygen isotopes, Carbon radioisotopes, Chlorine radioisotopes, Argon, Krypton, Bicarbonates, Carbon dioxide, Infiltration, Aquifers, Groundwater recharge, Surface, groundwater, gro face-groundwater relations

The present state of analytical techniques permits measurements of the heavy isotope content of the water molecules (2-H, 3-H, 18-O) as well as of specific isotopes (13-C, 14-C, 36-Cl, 39-Ar, 85-Kr) in solutes such as HCO3(-), CO2, Cl(-), and noble in solutes such as HCO3(-), CO2, Cl(-), and noble gases, with high detection sensitivity and low detection limit. Labelling of water with the environmental isotopes mentioned above occurs in the atmosphere and upper soil layers by isotopic fractionation effects during phase transitions or by uptake of cosmic-ray produced or manmade isotopes. Precipitation water, thus labelled, with respect to its distribution in space and time infiltrates into the aquifers. From the isotopic content of groundwater relative to the initial isotope content during infiltration and with simplifying assumptions concerning the flow, conclusions can be drawn for residence times, mixing processes and, sometimes, for the location of the recharge area of tions concerning the flow, conclusions can be drawn for residence times, mixing processes and, aometimes, for the location of the recharge area of the groundwater. The time scale of groundwater movement in these studies depends on the time scale of the variations in isotope content, subject to the influence of three different factors: the half-life of the radioactive nuclides under consideration (e.g. 14-C, 36-Cl, 39-Ar, 81-Kr), the climatic factors influencing the isotope fractionation (e.g. in the case of 2-H, 18-O), and the anthropogenic variations of the isotopic input (e.g. in the case of 3-H, 85-Kr). (See also W87-05100) (Author's abstract) stract) W87-05122

SINGLE WELL MEASUREMENTS AS A TOOL FOR DECONTAMINATION OF AN ARSENIC CONTAMINATED GROUNDWATER PLUME, Kiel Univ. (Germany, F.R.). Geologisch-Palaeontologisches Inst. und Museum. For primary bibliographic entry see Field 5B. W87-05123

DETECTION OF SUBSURFACE SEEPAGE BETWEEN AQUIFERS BY HYDROCHEMICAL

AND ENVIRONMENTAL ISOTOPIC TECHNIQUES - A CASE STUDY FROM SOUTH AUSTRALIA,
Flinders Univ. of South Australia, Bedford Park.
For primary bibliographic entry see Field 5B.
W87-05124

GROUNDWATER CHEMISTRY IN THE HAM-BURG REGION, Geologisches Landesamt Hamburg (Germany,

For primary bibliographic entry see Field 5B. W87-05125

GEOGENIC GROUNDWATER POLLUTION IN THE HAMBURG REGION, FR GERMANY, For primary bibliographic entry see Field 5B. W87-05126

HYDROGEOCHEMISTRY OF GROUNDWAT-ER IN THE DELHI REGION OF INDIA,
Jawaharlal Nehru Univ., New Delhi (India).
School of Environmental Sciences.

n, and K. K. Saxena. V. Subramanian, and K. K. Sakena.
IN: Relation of groundwater Quantity and Quality,
Proceedings of a Symposium Held During the
XVIIIth General Assembly of the International
Union of Geodesy and geophysics, Hamburg, FR
Germany, August, 1983. IAHS Publication No.
146. p 307-316, 7 fig. 2 tab, 14 ref.

Descriptors: *Geohydrology, *Geochemistry, *Groundwater chemistry, *Delhi, *India, Chemical analysis, Aquifers, Surface waters, Wastewater, Groundwater recharge, Iron, Manganese, Coppe, Lead, Zinc, Chromium, Salinity, Permeability co-

In the delhi region, India, groundwaters from various aquifers were sampled and chemically analyzed from 1978 to 1981. In addition, several types of surface water, sewage water and rain water in this area were also chemically monitored. Aquifer lithology, and the amount of recharge and discharge groundwater chemistry, is regulated by the chemical nature and the quantity of surface input. Based on these analytical data, water-mineral equilibria have been evaluated and compared to observed mineralogical composition of aquifer lithology. Limited trace metal analyses indicate the groundwater is not polluted with respect to Fe, Mn, Cu, Pb, Zn and Cr. Conductivity-salinity relationships have been established. Comparisons with the chemistry of groundwaters from similar aquifers in other parts of the world have also been made. (See also W87-05100) (Author's abstract) W87-05127

PETROLEUM HYDROCARBONS AND OR-GANIC CHEMICALS IN GROUND WATER -PREVENTION, DETECTION AND RESTORA-TION - A CONFERENCE AND EXPOSITION, National Water Well Association, Worthington,

For primary bibliographic entry see Field 5G. W87-05128

REGULATOR'S PERSPECTIVE ON PREVEN-TION OF LEAKS FROM UNDERGROUND STORAGE SYSTEMS, Maine Dept. of Environmental Protection, Augus-

For primary bibliographic entry see Field 5G. W87-05129

COMPUTERIZED DATA EVALUATION/MAN-AGEMENT FOR HYDROGEOLOGIC INVESTI-GATIONS,

GATIONS, Shell Oil Co., Houston, TX. For primary bibliographic entry see Field 7C. W87-05131

DRASTIC: A STANDARDIZED SYSTEM TO EVALUATE GROUND WATER POLLUTION POTENTIAL USING HYDROGEOLOGIC SET-

National Water Well Association, Worthington,

For primary bibliographic entry see Field 7C. W87-05132

MULTI-PHASE TRANSPORT OF PETROLE-UM HYDROCARBONS IN THE SUBSURFACE ENVIRONMENT: THEORY AND PRACTICAL APPLICATION.

EA Engineering, Science, and Technology, Inc., Sparks, MD. For primary bibliographic entry see Field 5B.

For primary bibliographic entry see Field 5B. W87-05133

MIGRATION AND APPARENT SUBSURFACE BIODEGRADATION OF ORGANIC COMPOUNDS IN A FRACTURED BEDROCK AQUI-

Dames and Moore, Cranford, NJ. For primary bibliographic entry see Field 5B. W87-05134

GROUND-SURFACE INTERACTION IN PRO-MOTION OF CONTAMINATION BY UNDER-GROUND STORAGE TANK LEAKAGE: A

CASE STUDY,
Southern Methodist Univ., Dallas, TX. Center for Urban Water Studies. For primary bibliographic entry see Field 5B. W87-05135

BIOTRANSFORMATION OF GASOLINE HY-DROCARBONS IN METHANOGENIC AQUI-FER MATERIAL,

Oklahoma Univ., Norman. Environmental and Ground Water Inst. For primary bibliographic entry see Field 5B. W87-05137

MICROBIAL DEGRADATION KINETICS OF ALCOHOLS IN SUBSURFACE SYSTEMS, Virginia Polytechnic Inst. and State Univ., Blacks-burg. Dept. of Civil Engineering. For primary bibliographic entry see Field 5B. W87-05138

NATURAL ATTENUATION OF AROMATIC HYDROCARBONS IN A SHALLOW SAND AQ-

Waterloo Univ. (Ontario). Dept. of Earth Sciences. For primary bibliographic entry see Field 5B. W87-05139

SORPTION AND DESORPTION OF DE-GREASING CHLOROORGANICS WITH SUB-SURFACE SEDIMENTS,

Missouri Univ.-Rolla. For primary bibliographic entry see Field 5B. W87-05140

EFFECTS OF CLAY MINERAL-ORGANIC MATTER COMPLEXES ON GASEOUS HY-DROCARBON EMISSIONS FROM SOILS,

Radian Corp., Austin, TX.
For primary bibliographic entry see Field 5B.
W87-05141

VOLATILE ORGANIC SCANS: IMPLICATIONS FOR GROUND WATER MONITORING Lockheed Engineering and Management Ser Co., Inc., Las Vegas, NV. For primary bibliographic entry see Field 5B. W87-05142

SAMPLING FOR TRACE LEVEL DISSOLVED HYDROCARBONS FROM RECOVERY WELLS RATHER THAN OBSERVATION WELLS, Amoco Corp., Tulsa, OK.

For primar W87-05143 rimary bibliographic entry see Field 5G. USE OF SOIL GAS SAMPLING TECHNIQUES FOR ASSESSMENT OF GROUND WATER CONTAMINATION, Warzyn Engineering, Inc., Madison, WI. For primary bibliographic entry see Field 5A. W87-05148

NEW GROUND WATER SURVEY TOOL: THE COMBINED CONE PENETROMETER/VADOSE ZONE VAPOR PROBE, McClelland Engineers, Inc., Houston, TX. For primary bibliographic entry see Field 5B. W87-03150

TOLUENE LOSS INVESTIGATION AND RE-MEDIAL ACTION AT TWO GEOLOGICALLY COMPLEX INDUSTRIAL SITES IN EASTERN

NEBRASKA, Hoskins-West Hoskins-Western-Sonderegger, Inc., Lincoln, NE. For primary bibliographic entry see Field 5B. W87-05153

DESIGN, INSTALLATION AND OPERATION OF WITHDRAWAL WELL CONTAMINANT RECOVERY SYSTEMS, Davis (Ken E.) Associates, Baton Rouge, LA. For primary bibliographic entry see Field 5G. W87-05154

ADVANTAGE OF UTILIZING MULTIPLE RE-COVERY WELLS FOR AQUIFER RESTORA-TION, Groundwater Technology, Inc., Concord, CA. For primary bibliographic entry see Field 5G. W87-03155

IN SITU BIOSURFACTANT PRODUCTION: AN AID TO THE BIODEGRADATION OF OR-GANIC GROUND WATER CONTAMINANTS, Tetra Tech, Inc., Pasadena, CA.
For primary bibliographic entry see Field 5G.
W87-05157

FULL SCALE GAC ADSORPTION PERFORM-ANCE COMPARED TO PILOT PLANT PRE-

DICTIONS, Kennedy/Jenks Engineers, San Francisco, CA. For primary bibliographic entry see Field 5F. W87-05159

CARBON ADSORPTION AS AN INTERIM RE-MEDIAL MEASURE AT PRIVATE WATER

WELLS, Warzyn Engin Warzyn Engineering, Inc., Madison, WI. For primary bibliographic entry see Field 5F. W87-05160

FEASIBILITY OF TREATING CONTAMINAT-ED GROUND WATER AT A HAZARDOUS WASTE SITE, GCA Corp., Bedford, MA. GCA Technology

For primary bibliographic entry see Field 5D. W87-05161

SUBSURFACE VENTING OF VAPORS EMA-NATING FROM HYDROCARBON PRODUCT ON GROUND WATER,

Radian Corp., Austin, TX.
For primary bibliographic entry see Field 5G.
W87-05162

SOIL DECONTAMINATION THROUGH IN SOIL DECONTAMINATION THROUGH IN STIU AIR STRIPPING OF VOLATILE ORGAN-ICS - A PILOT DEMONSTRATION, Weston (Roy F.), Inc., West Chester, PA. For primary bibliographic entry see Field 5G. W87-05163

GROUND WATER TREATMENT SYSTEM S and B Engineers, Inc., Houston, TX.

For primary bibliographic entry see Field 5F. W87-05164

2G. Water In Soils

LEACHING OF PHENOLIC COMPOUNDS FROM LEAF AND NEEDLE LITTER OF SEV-ERAL DECIDUOUS AND CONIFEROUS TREES, Vrije Univ., Amsterdam (Netherlands). Biological

For primary bibliographic entry see Field 5B. W87-04365

NITROGEN FIXATION (C2H2 REDUCTION) IN A SALT MARSH: ITS RELATIONSHIP TO TEMPERATURE AND AN EVALUATION OF AN IN SITU CHAMBER TECHNIQUE, South Carolina Univ., Columbia. Belle W. Baruch Inst. for Marine Biology and Coastal Research. For primary bibliographic entry see Field 2L. W87-04366

WATER-TABLE HEIGHTS AND DISCHARGE RATES WITH ARTESIAN FLOW TO INTER-CEPTOR LAND DRAINS, Rothamsted Experimental Station, Harpenden (England). Dept. of Soils and Plant Nutrition. For primary bibliographic entry see Field 2F. W87-04398

ANION EXCLUSION DURING TRANSPORT THROUGH THE UNSATURATED ZONE, Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2G.
W87-04399

ANION EXCLUSION DURING TRANSPORT THROUGH THE UNSATURATED ZONE Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
H. Gvirtzman, D. Ronen, and M. Magaritz.
Journal of Hydrology JHYDA7, Vol. 87, No. 3/4, p 267-283, October 30, 1986. 8 fig. 5 tab, 34 ref.

Descriptors: *Groundwater mover Descriptors: "Groundwater movement, "Tracers, "Isotope studies, "Path of pollutants, "Anions, "Anion exclusion, "Aeration zone, "Irrigation water, "Aquifers, Flow discharge, Tritium, Radioi-sotopes, Rain, Clay loam, Israel.

sotopes, Rain, Clay loam, Israel.

A 20-year chronological record of the flow of water and anions, along 27m., in the unsaturated zone of the phreatic Coastal Plain Aquifer of Israel was reconstructed. Water was traced according to its tritium content, using the difference between the environmental tritium content of rain and irrigation water. Anions were traced using data about their sequential input to the overlying cultivated field and their concentration in the profile. Evidences of anion exclusion were found along a 10m thick clay loam layer. The vertical velocities of water molecules and anions (SO4(2-) and Cl(-)) were calculated to be 0.7 + or - 0.05 and 1.35 + or - 0.05 m/yr, respectively. These field data fit and support the theoretical relationship between the water film thickness and the relative exclusion concentration proposed by Bresler in 1973. This study also suggested that the anion exclusion phenomenon cannot be neglected in the study of groundwater pollution rates or when establishing criteria for allowing fertilization and sewage irrigation above phreatic aquifers. (Wood-PTT)

SIMULATION OF THE SEEPAGE FACE - LIM-ITATIONS OF A ONE-DIMENSIONAL AP-

PRUACH, Agricultural Research Service, University Park, PA. Northeast Watershed Research Center. S. T. Potter, and W. J. Gburek. Journal of Hydrology JHYDA7, Vol. 87, No. 3/4, p 379-394, October 30, 1986. 9 fig. 24 ref.

Descriptors: *Seepage, *Groundwater movement, *Dupuit-Forchheimer approximations, *Mathemat-

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ical models, *Infiltration rate, Mathematical analysis, Mathematical equations, Mathematical studies, Uniform flow, Permeability coefficient.

Uniform flow, Permeability coefficient.

An approximate method for determining the length of seepage faces was presented based on the Dupuit-Forchheimer approximations. Analytical solutions based on the method were developed for three idealized flow systems. It was demonstrated that the D-F based solutions represent the entire flow system inclusive of the seepage face, and that incorporation of the D-F assumptions implies a uniform discharge along the seepage face proportional to the slope of the land surface and the saturated hydraulic conductivity. Seepage face lengths predicted by the D-F based solutions were compared to results from a two-dimensional finite-element model to establish error bounds under various boundary conditions. It was found that the error in prediction of seepage face length increases as either the land surface slope or the thickness-to-length ratio of the flow system increased. Additionally, discrepancies between the models were found to increase with increasing infiltration rates. The effects of radial flow were not found to significantly affect the D-F based solution. Considering the inadequate data base available to characterize most real world watersheds, numerical studies may not be warranted, and the D-F based solution of seepage face length is a reasonable approximation. (Author's abstract) seepage face length is a reasonable approximation. (Author's abstract)
W87-04405

WAYS TO DEVELOP METHODS OF DETER-MINING PERMEABILITY OF NONSATURAT-

For primary bibliographic entry see Field 8D. W87-04422

INFLUENCE OF IRRIGATION ON MATRIC POTENTIALS AND SOIL MOISTURE IN THE HOEGLWALD EXPERIMENT (EINFLUSS DER BEREGNUNG AUF MATRIXPOTENTIALE UND BODENDURCHFEUCHTUNG IM

UND BODENDURCHFEUCHTUNG IM HOEGLWALD EXPERIMENT), Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Bodenkunde. W. Grimmeisen, K. Kreutzer, and J. Bittersohl. Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 295-299, September 1986. 4 fig, 1 tab, 10 ref.

Descriptors: *Soil water, *Irrigation effects, *Soil water potential, *Matric potential, *Soil water suction, Soil moisture retention, Precipitation, Experimental design, Matrix poten-

In the Hoeglwald project, irrigation of the forest soil from May 1985 to November 1985 with 173 mm per year increased very distinctly the soil moisture of the upper soil layer down to 100 cm. On the irrigated plots the matric potential did not drop below -300 hPa, where as on the non-irrigated plots the matric potentials exceeded temporarily the measuring levels of tensiometers (-800 hPa). The irrigation effect reached down to 1 m, but it never led to a significant air deficit in any soil layer. (Author's abstract)

EFFECTS OF ACID IRRIGATION AND LIMING ON EXCHANGEABLE AND SOLU-BLE IONS IN THE SOIL (EINFLUSS VON SAUBER BEREGNUNG UND KALKUNG AUF AUSTAUSCHBARE UND GELOESTE IONEN WAR BOURSEN

IM BODEN), Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Bodenkunde. H. Reiter, J. Bittersohl, R. Schierl, and K.

Kreutzer.

Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 300-309, September 1986. 8 fig, 1 tab, 12 ref.

Descriptors: "Water pollution effects, "Irrigation, "Ions, "Soil solution, "Cations, "Manganese, Nirtates, "Liming, "Cation Exchange, "Groundwater, Sulfates, Forests, Bavaria, Calcium, Seasonal

First effects of the Hoeglwald acid irrigation and liming experiment on exchangeable and soluble

ions are described. Within two years of the experimental treatment, altogether 6.7 kmol/ha protons were applied to the soil. Of the cations, only manganese reacted on acid input with increasing concentrations in the equilibrium soil solution. The acid-supplied sulfate showed a time-lag during its vertical transfer through the humus layer. Concentrations of nitrate decreased. Eighteen months after liming with calcium-magnesium-carbonate, base saturation as well as concentrations of calcium and magnesium in the soil solution increased strongly saturation as well as contentations or calcium and magnesium in the soil solution increased strongly in the humus layer. Magnesium is displaced more quickly and in greater amounts than calcium. These processes are intensified by combining liming and acid irrigation. The nitrate concentrations show a minimum during the summer but increase heavily in late autumn (probably due to a temporary high bacterial demand for nitrogen). The lower part of the aeration zone is influenced The lower part of the aeration zone is influenced by calcareous tertiary layers, causing a pH level of 7.0 to 8.0 in leakage and groundwater. Concentrations of nitrate in groundwater of the spruce ecosystem amount to 30 mg/l. Increasing mineralization of nitrogen, caused by further interventions, may affect the quality of potential drinking water sources. (Author's abstract)

INFLUENCE OF ACID IRRIGATION AND LIMING ON HUMIC SUBSTANCES AND ON THE DYNAMICS OF ALUMINUM AND HEAVY METAL IONS IN AQUEOUS SOIL EX-TRACTS (EINFLUSS VON SAURER BEREG-NUNG UND KALKUNG AUF HUMUSSTOFFE SOWIE DIE ALUMINIUM- UND SCHWERME-TALLDYNAMIK IN WAESSRIGEN BODENEX TRAKTEN).

Munich Univ. (Germany, F.R.). Lehrstuhl fuer Bodenkunde.

Bodenkunde. R. Schierl, A. Goettlein, E. Hohmann, D. Truebenbach, and K. Kreutzer. Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 309-313, September 1986. 6 fig, 6 ref.

Descriptors: Water pollution effects, "Irrigation, "Soil solution, "Acid rain, "Air pollution effects, "Forests, "Heavy metals, "Aluminum, "Liming, "Humic acids, "Metal complexes, Bavaria, Dis-

Following liming, a significant mobilization of or-ganic material was detected in water extracts of samples from the upper soil horizons. Simulta-neously, higher concentrations of lead and copper ions were found (copper: 0.6-0.8 micromolar ion equivalents per I, Oh horizon). On all experimental notes, aluminum is in organic complexes to a bich equivalents per 1, On nortizon). On all experimental plots, aluminum is in organic complexes to a high degree in the O-horizon. Significant concentrations of monomerous aluminum species in mineral soil were found. (Airone-PTT) W87-04502

LONGITUDINAL DISPERSION TESTS IN NON-UNIFORM POROUS MEDIA, Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hun L. Ujfaludi. est (Hungary).

Hydrological Sciences Journal HSJODN, Vol. 31, No. 4, p 467-474, December 1986. 5 fig, 1 tab, 9 ref.

Descriptors: *Path of pollutants, *Dispersion coefficient, *Dispersivity, *Seepage, *Porous media, *Soil porosity, Soil testing, Pore size, Mathemati-

Systematic measurements of the longititudinal dispersion coefficient, D sub L, were made in 10 different soil samples. Four samples consisted of uniform grains and six non-uniform, composed by mixing the uniform samples. Tests yielded a linear relationship between D sub L and the seepage velocity, u, for both uniform and non-uniform samples. The process of dispersion between these are velocity, u, for both uniform and non-uniform sam-ples. The process of dispersion, however, has a complex character in non-uniform media, particu-larly in samples with a discontinuous grain size distribution curve. In such cases the value of D sub L may increase up to the value of D sub L for the coarser grained component depending on the devi-ation of the average grain size of the individual components. These irregular dispersion properties probably arise from the irregular pore-size distribu-

tion of the non-uniform samples. (Author's abstract) W87-04558

SUBSURFACE FLOW FROM A FORESTED SLOPE IN THE IFE AREA OF SOUTHWEST-

SLOPE IN THE IFE AREA OF SOUTHWEST-ERN NIGERIA, Ife Univ. (Nigeria). Dept. of Geography. L. K. Jeje, O. O. Ogunkoya, and E. Uyi. Hydrological Sciences Journal HSJODN, Vol. 31, No. 4, p 489-499, December 1986. 2 fig, 3 tab, 20 ref.

Descriptors: *Rainfall, *Soil moisture, *Permeability coefficient, *Storm seepage, *Seepage, *Soil horizons, *Forest soils, Nigeria, Slopes.

horizons, "Forest soils, Nigeria, Slopes.

Almost all studies on subsurface flow have been carried out in temperate regions, but information in the humid tropics is required. Lateral subsurface flow within a 10 per cent forested slope in a part of the humid tropics in southwestern Nigeria in 1982 is described, with particular regard to the cumulative amount, the timing and the frequency of seepage, the relative contributions of the various soil horizons to the total seepage, and the factors affecting these seepage parameters. Seepage was collected at 30, 500, 900, 1200 and 1800 mm depths by means of troughs connected to plastic collectors, and measurements were made between March and November 1982. The total amount of seepage during the study year was 67.7 mm and this was obtained from a total of 29 seepage days. This is considered low given the number of rainy days (106), the total rainfall for the period (924mm) and results from other environments. The impeding layer in the soil is within the 900-1200 mm horizon, but the largest relative contribution to total seepage was ever from the horizon impediestly where layer in the soil is within the 900-1200 mm horizon, but the largest relative contribution to total seepage was not from the horizon immediately above this layer (i.e. 500-900 mm), but from the surface 30 mm horizon. Soil moisture status and hydraulic conductivity as influenced by the rainfall pattern were found to be very important in controlling the seepage patterns. (Author's abstract) W87-04560

APPLICATION OF DRAINAGE THEORY IN THE FIELD,
Rothamsted Experimental Station, Harpenden Rothamsted Experimental Station, Harpenden (England).
G. D. Towner, and E. G. Youngs.
Soil Use and Management, Vol. 2, No. 2, p 44-47, June 1986. 3 fig. 11 ref.

Descriptors: *Model studies, *Drainage types, *Water table fluctuations, *Groundwater move-ment, *Drainage systems, Soil types, Permeability coefficient, Dip wells, Terrington Marsh, Loam,

The prediction of water table levels from ground-water theory for a drainage system in a uniform homogeneous soil was tested in an existing field system. The field, in Terrington Marsh, was re-claimed from the Wash in 1830 and consisted of system. The field, in Terrington Marsh, was reclaimed from the Wash in 1830 and consisted of soil which was a fine sandy loam with the small proportion of silt and clay decreasing with depth. Specifically designed meters recorded water table heights and drain discharge with time. A comprehensive hydraulic conductivity survey was made below the water table. The results agreed with the theory for water table heights up to about 300mm above the mean drain level. The drainage above that level was larger than predicted, either because of an increased hydraulic conductivity (which could have been produced by subsoiling the previous year and would not have been picked up by the hydraulic conductivity measurements), or because of the presence of an older shallower lateral drainage system, broken and blocked, that was discovered during the work. Attention was drawn to the inadequacies of dip wells for monitoring rapid changes in water table levels and to the problem of sample size in hydraulic conductivity measurements, which if too small could lead to apparent variability. (Wood-PTT)

INFLUENCE OF SOIL MACROPOROSITY ON WATER RETENTION, TRANSMISSION AND DRAINAGE IN A CLAY SOIL,

Water In Soils—Group 2G

Silsoe Coll. (England). P. B. Leeds-Harrison, C. J. P. Shipway, N. J. Jarvis, and E. G. Youngs. Soil Use and Management, Vol. 2, No. 2, p 47-50, June 1986. 5 fig, 1 tab, 16 ref.

Descriptors: "Mathematical models, "Hydrographs, "Soil water movement, "Soil macroporosity, "Water retention, "Water transmission, "Drainage, "Clays, Soil types, "Soil porosity, Soil properties, Permeabilty coefficient, Hydraulic properties.

The effect of continuous wetting on the hydraulic properties of swelling clay soils was investigated using cores which were taken from Evesham clay soil at Silsoe, Bedfordshire. Reductions in hydraulic conductivity and specific yield (drainable porosity) of the large cores were observed for periods up to 40 days under continuous ponding. A strong linear relationship (r squared = 0.94) found between these two variables was used as parameter input to a layered drainage model for mole drained soils. Model results indicated that soils of lower drainable porosity and hydraulic conductivity produced higher peaked hydrographs with faster recessions. The experimental relationships between hydraulic conductivity and soil porosity were used in conjunction with the developed model to assess the likely effects of soil loosening on drain outflow in heavy clay soils. (Wood-PTT)

MOLE DRAINAGE OF A HALLSWORTH

Ministry of Agriculture, Fisheries and Food, Cambridge (England). Field Drainage Experimental Unit.

Om...
A. C. Armstrong.
Soil Use and Management, Vol. 2, No. 2, p 54-58,
June 1986. 3 fig, 1 tab, 6 ref.

Descriptors: *Soil texture, *Mole drainage, *Halls-worth soil, *Drainage, *Drains, *Surface runoff, Water table fluctuations, Runoff, Agricultural management, Clays.

Mole drainage of the Hallsworth Series, which cover approximately 17% of Northern England and are characterized by clay-like textures, was compared with a traditional treatment of drains alone at 12m spacing. It was demonstrated that mole drainage offered superior control of water tables and reduced surface runoff. This could be expected to yield benefits in terms of an improved environment for crop roots and increased opportunities for the management of the land; several specific management implications of the results were discussed. (Wood-PTT)

RATIONAL FOR PERMEABLE BACKFILL PLACED OVER PIPE DRAINS,

Ministry of Agriculture, Fisheries and Food, Cambridge (England). Field Drainage Experimental Unit.

On. A. Castle.
Soil Use and Management, Vol. 2, No. 2, p 58-61,
June 1986. 3 fig, 17 ref.

Descriptors: *Permeable backfill, *Pipe drains, *Drainage, *Drainage design, Backfill, England, Mole drains, Subsoiler fissures, Subsoil drainage, Subsoil, Clays, Costs, Reviews.

Much field drainage work in Great Britain, where approximately 60% of the soils are clayey and require drainage when used for intensive arable or grassland farming, includes costly permeable backfill material as a connector between mole drains, subsoiler fissures, or permeable subsoil layers and the pipe. Permeable backfill is the hard, durable material of high hydraulic conductivity placed over drainage pipes to assist the flow of water to the pipe. The role of the Ministry of Agriculture in sponsoring research and advice on drainage design, as well as providing grant-aid to farmers for the installation of field drainage was reviewed. As a result of this involvement permeable backfill is now regarded as an essential element in the drainage of clayey soils and springs. The cost was fully

justified by the establishment and maintenance of highly efficient and flexible farming systems. (Wood-PTT) W87-04573

NITRATE LEACHING FROM A SMALL, UNDERDRAINED, GRASSLAND, CLAY CATCHMENT.

Oxford Univ. (England). Soil Science Lab. For primary bibliographic entry see Field 5B. W87-04575

COORDINATIVE INTERACTIONS BETWEEN SOIL SOLIDS AND WATER - AN AQUATIC CHEMIST'S POINT OF VIEW, Ecole Plytechnique Federale de Lausanne (Switzerland). Inst. for Resources and Water Pollution Control.

For primary bibliographic entry see Field 2K. W87-04584

MODELING OF SOLUTE TRANSPORT IN AGGREGATED/FRACTURED MEDIA INCLUDING DIFFUSION INTO THE BULK MATRIX, Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering. For primary bibliographic entry see Field 5B. W87-04585

MULTISPECIES CATION LEACHING DURING CONTINUOUS DISPLACEMENT OF ELECTROLYTE SOLUTIONS THROUGH SOIL COLUMNS, Florida Univ., Gainesville. Dept. of Soil Science. For primary bibliographic entry see Field 5B. W87-04586

MODEL OF ION TRANSPORT THROUGH A FORESTED CATCHMENT AT LANGE BRAMKE, WEST GERMANY,
Goettingen Univ. (Germany, F.R.). Abt. Bodenkunde und Waldernahrung.
For primary bibliographic entry see Field 5B. W87-04588

TRANSIENT MASS-TRANSPORT IN THE PRESENCE OF NON-LINEAR PHYSICO-CHEMICAL INTERACTION LAWS: PROGRESIVE MODELLING AND APPROPRIATE EXPERIMENTAL PROCEDURES, Centre National de la Recherche Scientifique, Nancy (France). Lab. des Sciences du Genie Che-

For primary bibliographic entry see Field 5B. W87-04589

MIGRATION OF SOLUTES IN A CULTIVAT-ED SOIL: EFFECT OF PLOUGHING, Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). W. Schimmack, and K. Bunzl. Geoderma GEDMAB, Vol. 38, No 1-4, p 155-163, September 1986. 9 fig., 7 ref.

Descriptors: "Path of pollutants, "Soil horizon, "Solute transport, "Cultivated lands, "Plowing effects, "Model studies, "Mathematical models, Mathematical equations, Leaching, Radionuclides, Retardation factors, Calculations.

The vertical transport of solutes in a cultivated soil, which was plowed annually was investigated by model calculations. Plowing was simulated in two ways: mixing (homogeneous distribution of the solute in the A sub p horizon) and turnover (inversion of the solute distribution). During the first years after application of the solute to the soil surface both plowing procedures resulted in an enhanced leaching of the radionuclides out of the A sub p horizon into the B horizon, turnover being more effective than mixing. However, after a certain time interval, which depended on the retardation factors of the solute in the two soil horizons, the situation was reversed: plowing resulted in a retarded leaching of the solute out of the A sub p horizon. It was also shown to what extent the

effect of plowing on the vertical migration of the solute depended on the retardation factors of the solute, the thickness of the A sub p horizon and the lag time between application of the solute to the soil surface and first plowing. (Author's abstract) W87-04590

MODELS FOR SIMULATING SALT MOVE-MENT IN AGGREGATED FIELD SOILS, Agricultural Research Service, Riverside, CA. Salinity Lab.

Agricultural No. 1 Agricultural

Descriptors: *Path of pollutants, *Reviews, *Soil porosity, *Salt movement, *Soil aggregates, *Mathematical studies, *Mathematical models, *Solutes, Mathematical equations, Convection, Dispersion, Aggregates, Dispersion coefficient, Equilibrium transport equation.

Several 'two-region' type models for simulating salt movement in aggregated soils were reviewed. A common feature of these models was the assumption that solutes were transported by convection and dispersion through well-defined pores or cracks, while diffusion-type equations were used to describe solute transfer inside the soil micropores. Analytical solutions were available for several aggregate shapes (spherical, cylindrical and line-sheet type aggregates). A recently developed transformation extended the two-region modeling approach to more general conditions involving aggregates of arbitrary geometry. The method was based on the replacement of a given aggregate soil by a reference soil made up of uniformly-sized spherical aggregates with the same average diffusion properties as the original soil. The transformations worked well except for soils which contained hollow cylindrical macropores. The method could also be used to quantify the mass transfer coefficient in a first-order rate model for solute exchange between mobile and immobile liquid zones. An advantage of the first-order approach was that it could be included easily in relatively simple management-oriented models using parameters that could be given a physical interpretation. This model gave an excellent approximation for transport through hollow cylindrical macropores, but was considerably less accurate for spherically aggregated and related systems. Several previously unpublished expressions, derived using Laplace transform techniques, that lump the effects of intraaggregate diffusion into an effective dispersion coefficient for use in the classical two-parameter equilibrium transport equation were presented. (Wood-PTT)

APPLICATION OF SIMPLE LEACHING MODELS IN HETEROGENEOUS SOILS, Rothamsted Experimental Station, Harpenden (England).

(England).

T. M. Addiscott, P. J. Heys, and A. P. Whitmore.
Geoderma GEDMAB, Vol. 38, No. 1-4, p 185-194,
September 1986. 4 fig, 1 tab, 17 ref.

Descriptors: "Path of pollutants, "Leaching, "Heterogeneous soils, "Soil moisture, "Solutes, "Madhematical studies, "Mathematical studies, "Mathematical equations, Nitrates, Clay loam, Batcombe series, Rothamsted, Burns equation.

The simple leaching model described divided the soil into layers, each containing an amount of mobile water w sum m, defined simply by w sub m > 0 and an amount of immobile water w sub r, that was determined by the soil moisture characteristic. Solute moved downward through the mobile water only, but may also move laterally between the mobile and immobile water. Water and solute entering each layer were added to wunder and solute entering each layer were added to wunder and solute solute it contained moved to the layer below. Of the input variates, w sub r and alpha had most control on leaching, so to test the model for the effects of input variability, these variates were supplied as single mean values or as distributions in simulations of a field experiment. In this experiment nitrate was applied to the soil surface of

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twelve plots of flinty clay loam of the Batcombe series at Rothamsted and allowed to leach under natural winter rainfall for two months before the plots were sampled in 15 cm layers to 75 cm. Supplying w sub r and alpha as single mean values gave quite good simulations of the mean percentage recoveries of applied nitrate in the layers, and these could be improved slightly by replacing the single value of w sub r by its distribution. No further improvement in the simulation of the mean recoveries was achieved by supplying alpha as a distribution. The variances of the percentage recoveries in the layers were simulated reasonably successfully, but only when both w sub r and alpha were supplied as distributions. (Wood-PTT) W87-04592

EVIDENCES FOR THE EXISTENCE OF A RETENTION PHENOMENON DURING THE MIGRATION OF A MERCURIAL SOLUTION THROUGH A SATURATED POROUS MEDIUM

Strasbourg-1 Univ. (France). Inst. de Mechanique des Fluides. For primary bibliographic entry see Field 5B. W87-04593

STUDY OF TRACER MOVEMENT THROUGH UNSATURATED SAND, Vrije Univ., Brussels (Belgium). Lab. of Hydrolo-

gy. F. De Smedt, F. Wauters, and J. Sevilla. Geoderma GEDMAB, Vol. 38, No. 1-4, p 223-236, September 1986. 11 fig, 1 tab, 24 ref.

Descriptors: *Path of pollutants, *Tracers, *Triti-um, *Sand, *Solute displacement, *Saturated flow, *Dispersivity, *Mathematical equations, Radioiso-topes, Heavy water, Leaching, Hydrodynamic dis-

A column of 100 cm length and 15.4 cm diameter was filled with sand. A solute displacement experiment, using tritium as tracer, was conducted under asturated water flow conditions. Analysis of the observed effluent concentration resulted in an estimate of the control of the c mated dispersivity of 0.094 cm. Solute displa mateu dispersivity of 0.09% cm. Soliule displace-ment experiments under unsaturated water flow conditions were conducted, by leaching the column intermittedly on a daily basis with constant amounts of water. Three such experiments were conducted with respectively 100 cc, 250 cc and 500 cc of water inflitrated daily. The parameters of the hydrodynamic dispersion equations were fitted 500 cc of water infiltrated daily. The parameters of the hydrodynamic dispersion equation were fitted to the observed effluent concentrations. Very large dispersion coefficients were obtained with a dispersivity of about 7.3 cm. Hence, changing from saturated to unsaturated conditions increases the dispersivity by a factor of about 80. A dispersion convection equation with mobile and immobile water phases was also fitted to the data and for all experiments it was found that about 36% of the water in the unsaturated column could be considered immobile. The dispersivity in the mobile zone was found to be slightly larger than for saturated conditions. (Author's abstract)

TIME-DOMAIN REFLECTOMETRY METHOD FOR MEASURING SOIL WATER CONTENT AND SALINITY,

AND SALINITY, Agricultural Research Service, Riverside, CA. Sa-linity Lab. F. N. Dalton, and M. T. Van Genuchten. Geoderma GEDMAB, Vol. 38, No. 1-4, p 237-250, September 1986. 7 fig. 1 tab, 14 ref.

Descriptors: *Pollutant identification, *Time-domain reflectometry method, *Soil solution, *Soil water, *Salinity, *Solute transport, *Conductivity, *Mathematical equations, Sensors, Ion transport.

The physical principles and use of time-domain reflectometry as a new tool for studying water and solute transport in saturated soils were investigated. In-situ simultaneous measurements of water content and bulk soil electrical conductivity are shown to give results that are comparable with those obtained by conventional non-destructive techniques. Because sampling volumes for the two

surements are identical, the simultaneous meas measurements are identical, the simultaneous measurement seems useful for spatial variability studies involving heterogeneous soils. An equation is presented that relates the bulk soil electrical conductivity. Also derived are constraints that water content and electrical conductivity place on the use of time domain reflectometry sensors. (Wood-PTT)

CHEMICAL TRANSPORT UNDER NO-TILL FIELD CONDITIONS,
Science and Education Administration, Beltsville,

For primary bibliographic entry see Field 5B. W87-04596

MULTICOMPONENT TRANSPORT MODEL, Goettingen Univ. (Germany, F.R.). Abt. Boden-kunde und Waldernahrung. For primary bibliographic entry see Field 5B. W87-04597

EXPECTED SPECIATION OF DISSOLVED TRACE METALS IN GRAVITATIONAL WATER OF ACID SOIL PROFILES, Ecole Polyechnique Federale de Lausanne (Switzerland). Inst. de Genie Rural. For primary bibliographic entry see Field 5B. W87-04598

SORPTION KINETICS AND TRANSPORT OF PHOSPHATE IN SANDY SOIL, Agricultural Univ., Wageningen (Netherlands). Dept. of Soil Science and Geology. For primary bibliographic entry see Field 5B. W87-04599

MODELLING THE BEHAVIOUR OF ORGAN-IC CHEMICALS IN SOIL AND GROUND for Pesticide Research, Wageningen

Institute for (Netherlands). For primary bibliographic entry see Field 5B. W87-04613

EVENT-BASED SIMULATION MODEL OF MOISTURE AND ENERGY FLUXES AT A BARE SOIL SURFACE, Princeton Univ., NJ. Dept. of Civil and Geological

P. C. D. Milly. Water Resources Research WRERAQ, Vol. 22, No. 12, p 1680-1692, November 1986. 12 fig., 4 tab, 21 ref. NSF Grants ATM-7812327, ATM-8114723, and CEE-8307282.

Descriptors: *Simulation, *Mathematical models, *Soil water, *Soil water, *Energy, *Hydrologic budget, Soil physics, Differential equations, Soil heat flux, Soil temperature.

Land surface energy and water balances can be calculated by solving the partial differential equations governing vertical water and heat flow in the soil. As an alternative to computationally intensive procedures, some accuracy can be forfeited in exchange for reduced computational effort by using an event-based simulation model. Because the model uses closed-form solutions of the governing equations as basic building blocks, the event-based model avoids most of the work associated with discretization. The use of time condensation and simplified soil moisture kinematics allows these closed-form solutions to serve in continuous simulations. simplified soil moisture kinematics allows these closed-form solutions to serve in continuous simulations under randomly varying forcing. A modified force-restore model of soil temperature provides the necessary link between the energy and water balance. Compared to finite element solutions of a detailed set of partial differential equations governing heat transport in soil, the event-based model closely reproduced the average energy and water balances and surface temperatures and decreased computational effort by a factor of at least 100. (Author's abstract) EFFECT OF RADIAL FLOW ON DEVIATIONS FROM LOCAL EQUILIBRIUM DURING SORBING SOLUTE TRANSPORT THROUGH HOMOGENEOUS SOILS, Illinois Univ. at Urbana-Champaign. Dept. of Civil Pagingagin.

Engineering.
For primary bibliographic entry see Field 5B.
W87-04759

LINEARIZED UNSTEADY MULTIDIMEN-

LINEARIZED UNSTEADY MULTIDIMEN-SIONAL INFILTRATION, Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Envi-ronmental Mechanics.

Water Resources Research WRERAQ, Vol. 22, No. 12, p 1717-1727, November 1986. 4 fig, 1 tab,

Descriptors: *Mathematical equations, *Unsaturated flow, *Infiltration, *Soil water, Equations, Cavities, Steady flow, Homogeneous soils.

The parameters in the linearized multidimensional unsteady equation for unsaturated flow in homogeneous soils can be chosen so that small time flow rates are given correctly, with the quasi-linear steady solution as the large time limit. Matched in this way, the linearized equation offers insight into the time course of multidimensional infiltration. In this paper the following aspects are considered: unsteady infiltration from buried cavities, unsteady infiltration flow form spherical cavities, unsteady infiltration from cylindrical cavities, theorems on unsteady infiltration from cavities of arbitrary shape, the functions G(r,s,t) and g(tau), characteristic lengths and time to unsteady infiltration from cavities of arbitrary shape, the functions G(r,s,t) and g(tau), characteristics lengths and time to unsteady indicates. istics lengths and times in unsteady multidimen-sional infiltration, and time scales of approach to steady state. Analysis of the influence of two char-acteristic times on the time scales of approach to acteristic times on the time scales of approach to steady moisture distribution near the supply sur-face and to steady discharge provides and explana-tion of the relatively rapid approach to the steady state observed in three-dimensional infiltration from small supply surfaces. (Rochester-PTT)

EFFECT OF LOCAL GROUND SLOPE ON THE PERFORMANCE OF TILE DRAINS IN A CLAY

London Univ. (England). Dept. of Geography. For primary bibliographic entry see Field 4A. W87-04859

EFFECT OF THE STRUCTURAL STATE OF THE PLOUGHED LAYER ON ITS WATER RE-TENTION (EFFET DE L'ETAT STRUCTURAL D'UNE COUCHE LABOUREE SUR SA RETEN-TION EN EAU), Institut National de la Recherche Agronomique,

Paris (France).

F. Papy. Agronomie AGRNDZ, Vol. 6, No. 6, p 555-565, Agronomie AGKNDZ, 1986. 8 fig, 7 tab, 16 ref.

Descriptors: *Water retention, *Soil structure, *Hydraulic properties, *Infiltration, *Plowing, Spatial distribution, Soil profiles, Hydraulic permeability, Morphology.

An important feature of the plowed layer of the soil is the spatial variability of its structure with the presence of subvertical discontinuities. This heterogeneity can be considered in distinguishing several layers in the description of the structural state. A survey to analyze the influence of each of these levels on the water retention of the plowed layer was conducted. Plowed layer structure was determined by mapping homogeneous units at the decimeter scale located on a vertical section of a profile. Each of these morphological units could be characterized by the internal state of its structural elements and mode of assembly. In a given plowed layer, structural discontinuities existed in ponderal water content, but tensiometer records indicated continuous hydraulic load profiles. The difference in the pF ponderal water content relation between morphological units established in the laboratory explained the observations made in situ. In the pF range encountered during spring plowing, the age encountered during spring plowing,

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structural elements with a compact internal state had the lowest ponderal water content. Comparison of the hydric behavior of two types of plowed layers showed that in blocks separated by voids, the gaps between blocks were preferential paths for water infiltration resulting in less imbibition of compact blocks. To explain the hydric behavior of a plowed layer, different phenomena must be involved at different levels for the structural state description. One result of this study concerns a way of determining work days for plowing. (Author's abstract) way of determithor's abstract) W87-04864

EFFECTS OF TEMPERATURE AND PRIOR FLOODING ON INTENSITY AND SORPTION OF PHOSPHORUS IN SOIL: I. EFFECTS ON THE KINETICS OF SOLUBLE P IN SOIL, California Univ., Davis. Dept. of Agronomy and Range Science.
R. N. Sah, and D. S. Mikkelsen.
Plant and Soil PLSOA2, Vol. 95, No. 2, p 163-171,

1986. 7 fig, 2 tab, 14 ref.

Descriptors: *Temperature effects, *Flooding, *Sorption, *Phosphorus, *Soil chemistry, *Nutrients, *Crop production, *Kenetics, Soil types, Rice, Fertilizers, Clays.

Rice, Fertilizers, Clays.

Effects of temperature and flooded-drained soil conditions on 0.01 M CaCl2 extractable phosphorus (soluble P) were investigated in four soils over the period of 42 days after fertilizer-P application. Crops grown in these soils showed severe induced P deficiency problems following flooded rice culture. The effects of temperature on the reaction rate constants were determined and activation energy was calculated. Increasing soil temperature as well as prior flooding of soil decreased soluble P concentration, but the effect of the latter was dominant. The decrease in soluble P concentration in these soils with time followed a first order kinetics, and the rate constant increased as the temperature increased from 10 C to 30 C. The activation energy for the kinetics of soluble P concentration in soil, as affected by temperature, was found to be 8.9 and 34.5 KJ/mol for Meyers and Willows clay, respectively, over the temperature range studied. (See also W87-04893) (Author's abstract)

EFFECTS OF TEMPERATURE AND PRIOR FLOODING ON INTENSITY AND SORPTION OF PHOSPHORUS IN SOIL: IL EFFECTS ON

OF PHOSPHOKUS IN SOIL: II. EFFECTS ON PSORPTION, California Univ., Davis. Dept. of Agronomy and Range Science.
R. N. Sah, and D. S. Mikkelsen.
Plant and Soil PLSOAZ, Vol. 95, No. 2, p 173-181, 1986. 5 fig, 4 tab, 20 ref.

Descriptors: *Temperature effects, *Flooding, *Sorption, *Phosphorus, *Soil chemistry, *Nutrients, *Crop production, Chemical reactions, Soil types, Rice, Clays, Kinetics, Mathematical analysis, Isotherms, Thermodynamics.

The effects of temperature and prior flooding of soil on P sorption were examined in two soils having a rice-based cropping system and showing an induced P deficiency problem in flooded rice-uplant crop rotations. The P sorption capacity of soil increased with increasing temperature as well as with prior flooding; the effects of the latter were dominant. The bonding energy of sorption, calculated from the Langmuir isotherm, also increased with both temperature and prior flooding of soils, indicating that the effects of chemical changes associated with alternative anoxic and oxidized soil conditions are more significant in the P reversion process. The apparent heat of sorption reaction, calculated with the Freundikch isotherm and Van't Hoff's equation, also increased due to prior flooding of soil. (See also W87-04892) (Author's abstract) stract) W87-04893

POTASSIUM AVAILABILITY IN RELATION TO SOIL MOISTURE: I. EFFECT OF SOIL MOISTURE ON POTASSIUM DIFFUSION,

ROOT GROWTH AND POTASSIUM UPTAKE

ROUT GROWTH AND FOTASSIUM OFFARE OFFONION PLANTS, Goettingen Univ. (Germany, F.R.). Inst. fuer Agri-kulturchemie. R. Kuchenbuch, N. Classen, and A. Jungk. Plant and Soil PLSOA2, Vol. 95, No. 2, p 221-231, 1986. 6 fig, 2 tab, 21 ref.

Descriptors: *Bioaccumulation, *Potassium, *Nutrients, *Soil-water-plant relationships, *Soil water, *Roots, *Onions, *Solute transport, *Plant growth, Soil types, Crop production, Fertilizers, Growth, Accumulation.

Accumulation.

The influence of soil water content on the mobility of potassium in soil, plant growth, and K uptake of plants was investigated. The mobility of K increased with soil moisture. Increasing the volumetric water content (theta) from 0.1 to 0.4 resulted in a rise of the effective diffusion coefficient (D sub e) by a factor of 10, mainly due to the increase of the tortuosity or impedance factor with higher soil moisture. In order to relate K mobility in soil to the availability of K for plant uptake, onion plants were grown in special containers under constant volumetric water content in the range of 0.1 to 0.4. It was found that (1) both K content and growth of the plants increased with soil moisture, (2) water content below theta = 0.1 reduced root growth, and (K inflow per unit of root surface increased with soil moisture. Maximum rate of inflow occurred with theta = 0.25 in the soil used. It is concluded that soil moisture affected K availability by affecting both K mobility and root growth. (See also W87-04895) (Author's abstract)

POTASSIUM AVAILABILITY IN RELATION TO SOIL MOISTURE: II. CALCULATIONS BY MEANS OF A MATHEMATICAL SIMULA-

MEANS OF A MATHEMATICAL SIMULA-TION MODEL, Goettingen Univ. (Germany, F.R.). Inst. fuer Agri-kulturchemie. R. Kuchenbuch, N. Classsen, and A. Jungk. Plant and Soil PLSOA2, Vol. 95, No. 2, p 233-243, 1986. 4 fig, 3 tab, 17 ref.

Descriptors: "Bioaccumulation, "Simulation, "Mathematical models, "Potassium, "Soil water, "Soil-water-plant relationships, "Nutrients, "Solute transport, "Model studies, Roots, Model studies, Soil types, Loess, Sand, Accumulation, Onions, Soil water potential, Water potentials, Soil texture, Soil physical properties.

A simulation model was used to study the influence of soil moisture on the availability of potassium. Calculations from a loess soil have shown that decreasing water content resulted in (1) a strong decrease of K transport from the soil to the root, (2) a faster decrease of the K concentration at the root surface, and therefore (3) increasingly steep gradients of the K concentration around the root. With the root density found in this experiment, the K concentration of the moist soil decreased almost equally in the total soil volume, whereas in the dry soil not much change occurred in the middle between two roots. Therefore, the rate of K uptake per unit of root decreased much faster in the dry than in the moist soil. Calculations for sandy and loess soils, which have different water tension curves, have shown that the availability of K in the sandy soil is much more sensitive to changes in water tension than in the loess soil. It is concluded that the simulation technique can be used to analyze the influence of single factors on the availability of K and to estimate the extent of this influence. (See also W87-04894) (Author's abstract)

TECHNIQUE FOR ECOLOGICAL STUDIES OF SEED GERMINATION IN RELATION TO SOIL WATER POTENTIAL, University Coll., Cork (Ireland). Dept. of Plant

For primary bibliographic entry see Field 2I. W87-04898

EFFECT OF SUBSOILING AND IRRIGATION ON POTATO PRODUCTION.

Department of Scientific and Industrial Research, Lower Hutt (New Zealand). For primary bibliographic entry see Field 3F. W87-04913

SOIL STRENGTH, SLOPE, AND RAINFALL INTENSITY EFFECTS ON INTERRILL ERO-SION,

Iowa State Univ., Ames. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2J.
W87-04918

PARAMETER VALUE PREDICTION FOR HOLTAN'S INFILTRATION EQUATION, Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineerin ricultural Engineering.
L. K. Ewing, and J. K. Mitchell.
Transactions of the ASAE TAAEAJ, Vol. 29, No.
1, p 170-175, January-February 1986. 8 fig. 3 tab, 9

Descriptors: *Holtan's infiltration equation, *Algorithms, *Hydrographs, *Estimating equations, *Infiltration, *Soil properties, Hydrology, Hydrologic cycle, Model studies.

Infiltration is an important component of the hydrologic cycle and is considered in the solution of water management and soil conservation problems. For surface irrigation, infiltration capacity rates of a soil need to be known to schedule the replacement of the soil moisture which crops can use. Estimation of peak runoff rates or runoff volumes for the design of runoff or erosion control structures or management practices requires the abstraction of infiltration from rainfall. The importance of infiltration in many situations is evident from the many empirical and physically based infiltration equations which have been proposed and used. An algorithm was developed for predicting parameter values of a modified Holtan infiltration equation from observed data commonly measured parameter values of a modified Holtan infiltration equation from observed data commonly measured from small hydrologic plots. The applicability of predicted parameter values to predict infiltration rates on other plots having similar soil characteristics was studied. Physically reasonable parameter values were predicted and were applicable for prediction of infiltration on other plots. Occasionally physically unrealistic values were predicted and were not applicable for prediction of infiltration on other plots. A primary reason for this result was the use of mean values for the parameters representing constant infiltration capacity after mean wetting and maximum potential increase of infiltration capacity. The use of harmonic means of parameter values from five plots gave more applicable results. (Alexander-PTT)

PREDICTING UNSATURATED HYDRAULIC CONDUCTIVITY FROM THE SOIL WATER CHARACTERISTIC,

Integrated Systems, Inc., San Jose, CA.
L. Alexander, and R. W. Skaggs.
Transactions of the ASAE TAAEAJ, Vol. 29, No.
1, p 176-184, January-February 1986. 8 fig. 5 tab,
45 ref.

Descriptora: "Hydraulic conductivity, "Unsaturated flow, "Soil water movement, "Permeability coefficient, "Mathematical models, "Soil water, "Statistical analysis, Soil properties, Numerical analysis, Soil types, Clays, Loam, Sand, Prediction, Model studies.

Mathematical models of soil water movement frequently use the unsaturated hydraulic conductivity, K, as a function of soil water tension (or matric potential), h. The K(h) function is soil specific and its measurement is difficult and time consuming. Fourteen methods to predict the unsaturated hydraulic conductivity function, K(h) from the soil water characteristic, theta(h), were examined. Nine of the fourteen methods were found in the literature; the other five were developed by modifying some of the original nine. All methods were tested using measured K(h) data for 23 soils found in the literature. Predictions were compared statistically and graphically to the laboratory-measured K(h)

Group 2G-Water In Soils

for each soil. Results showed that the best method of predicting K(h) for the sandy and clayey soils examined was a new closed-form equation for K(h) which uses the Campbell (1974) equation for theta(h). This method also worked best for the low K values of the loamy soils. The choice of this method was based on the assumption that a conservation or 'afe side' estimate will be obtained when K(h) is overpredicted. A numerical approximation to this new form for K(h) provided the best estimate of K(h) values near saturation for the loamy soils. When underestimation of K(h) yields the conservative result, the following method gave the best results: (a) A numerical approximation to the Burdine (1953) closed-form equation for sandy soils; (b) The Burdine equation for K(h) combined with the Campbell form for theta(h) for the clayey soils near saturation; (c) A closed-form equation for K(h) developed by Mualem (1976) combined with the Brooks and Corey (1964) form for theta(h) for the low K(h) values for clayey soils. (Alexander-PTT)

GROUP INVARIANCE AND FIELD-SCALE SOLUTE TRANSPORT, California Univ., Riverside. Dept. of Soil and Environmental Sciences

For primary bibliographic entry see Field 5B.

THREE-DIMENSIONAL FINITE-ELEMENT MODEL FOR SIMULATING WATER FLOW IN VARIABLY SATURATED POROUS MEDIA.

GeoTrans, Inc., Herndon, VA. P. S. Huyakorn, E. P. Springer, V. Guvanasen, and T. D. Wadsworth.

Water Resources Research WRERAQ, Vol. 22, No. 13, p 1790-1808, December 1986. 14 fig, 4 tab, 19 ref, append. USDA-ARS Contract 53-3X06-4-82

Descriptors: *Finite element models, *Groundwater movement, *Soil water movement, *Mathematical models, *Model studies, *Simulation analysis, *Porous media, *Saturated flow, *Unsaturated flow, Boundary conditions, Seepage, Infiltration, Algorithms, Computers, Calibrations, Soil properties, Drainage, Unconfined aquifers, Embankments.

A three-dimensional finite-element model for simulating water flow in variably saturated porous media is presented. The model formulation is general and capable of accommodating complex boundary conditions associated with seepage faces and infiltration or evaporation of the soil surface. Included in this formulation is an improved Picard algorithm designed to cope with severely nonlinear soil moisture relations. The algorithm is formulated for both rectangular and triangular prism elements. The element matrices are evaluated using an 'influence coefficient' technique that avoids coutly numerical integration. Spatial discretization of a three-dimensional region is performed using a vertical slicing approach designed to accommodate complex geometry with irregular boundaries, layering, and/or lateral discontinuities. Matrix solution is achieved using a slice successive overrestantion scheme that permits a fairly large number of nodal unknowns (on the order of several thousand) to be handled efficiently on small minicomputers. Six examples are presented to verify and demonstrate the utility of the proposed finite-element model. The first four examples concern one-and two-dimensional flow problems used as sample problems to benchmark the code: (1) steady drainage to parallel drains; and (4) transient flow in a soil column subjected to infiltration and subsequent evaporation. The remaining examples concern three-dimensional problems: (1) three-dimensional flow in a frained field; and (2) three-dimensional flow in a f

STEADY INFILTRATION FROM SPHEROI-DAL CAVITIES IN ISOTROPIC AND ANISO-TROPIC SOILS.

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Environmental Mechanics. J. R. Philip.

Water Resources Research WRERAQ, Vol. 22, No. 13, p 1874-1880, December 1986. 6 fig, 1 tab, 20 ref.

Descriptors: *Infiltration, *Soil water movement, *Soil properties, *Model studies, *Pores, *Numerical analysis, Cavities, Isotropy, Anisotropy, Discharge, Wetting, Soil types, Capillarity, Gravity flow, Boreholes, Permeability.

Solutions are given for quasilinear steady infiltration from spheroidal cavities (with axis of rotational symmetry vertical) of arbitrary aspect ratio nu into isotropic and anisotropic homogeneous soils. The conductivity tensor is assumed to have principal components Kappa (Psi), Kappa (Psi), and mu squared Kappa (Psi), the third of these in the vertical direction. Here mu squared is the anisotropy, and Psi is the moisture potential. Scattering analog techniques are used to secure the required solutions. The exact solutions involve spheroidal wave functions; but, more usefully, we express the far field wetting function and the discharge function as expansions appropriate for small and large values of s, the dimensionless transformed equatorial radius of the cavity. A joining technique is used to establish estimates of the discharge function throughout the ranges 0 < or = s < or = infinity, 0 < or = omega < or = 20, with transformed aspect ratio omega = nu/mu. The effect of anisotropy on cavity discharge increases systematically both as nu decreases from infinity to 0, and as sigma (= s/mu) increases from 0 to infinity. This behavior is explained physically in terms of interaction between, on the one hand, cavity configuration and orientation, and, on the other, the relative importance of capillarity and gravity. The analysis provides means of improving the approximate analysis of the borchole permeameter in isotropic soils, and of investigating the properties of borehole and disc permeameters in unsaturated anisotropic soils. (Author's abstract)

VELOCITY-DEPENDENT HYDRODYNAMIC DISPERSION DURING UNSTEADY, UNSATURATED SOIL WATER FLOW: EXPERIMENTS, Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils. For primary bibliographic entry see Field 5B. W87-04951

PARTICLE TRANSPORT THROUGH POROUS MEDIA,
California Univ., Berkeley. Dept. of Civil Engi-

neering. For primary bibliographic entry see Field 5B. W87-04953

TRANSPORT OF DISSOLVED HYDROCAR-BONS INFLUENCED BY OXYGEN-LIMITED BIODEGRADATION: 1. THEORETICAL DE-VELOPMENT,

North Carolina State Univ. at Raleigh. For primary bibliographic entry see Field 5B. W87-04959

TRANSPORT OF DISSOLVED HYDROCAR-BONS INFLUENCED BY OXYGEN-LIMITED BIODEGRADATION; 2. FIELD APPLICATION, North Carolina State Univ. at Raleigh. For primary bibliographic entry see Field 5B. W87-04960

RADON AND RADIUM EMANATIONS FROM FRACTURED CRYSTALLINE ROCKS - A CON-CEPTUAL HYDROGEOLOGICAL MODEL, For primary bibliographic entry see Field 5B. W87-05068

USE OF ELECTROMAGNETIC INDUCTION FOR LOCATING SUBSURFACE SALINE MATERIAL.

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Water and Land Resources. B. G. Williams, and F. T. Fidler.

and Land Resources.

B. G. Williams, and F. T. Fidler.

IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 189-196, 5 fig, 1 tab, 5 ref.

Descriptors: *Geophysics, *Electromagnetic studies, *Saline soils, *Subsurface mapping, *Water pollution sources, Salinization, Australia, Irrigation, Conductivity, Major Creek, Sedimentology.

Conductivity, Major Creek, Sedimentology.

Secondary salinization of surface soils affects approximately \$00,000 ha of dryland agricultural soils and 120,000 ha of irrigated land in Australia. Electromagnetic induction (EM), by measuring the apparent electrical conductivity (ECa) of soil profiles, provides a rapid method for detecting subsurface saline material. An area of 706 sq km was surveyed, using the EM technique, to locate materials that are contributing to a large salt outflow from the Major Creek drainage basin in Victoria, Australia. Values of ECa ranged from <10 to 145 milli-S/m and were strongly correlated (R = 0.85) with soluble salt contents to depths of 6-15 m. Sediments from the Devonian Puckapunyal Formation and its associated Quaternary overburden had ECa values of about twice that of other Devonian Formations or neighboring Silurian sediments. Some anomalously high electromagnetic readings were obtained that could not be associated with soluble salt content alone. (See also W87-05100) (Author's abstract) W87-05117

GEOCHEMICAL EVOLUTION OF WATERS AND SOIL SOLUTION DURING THEIR CONCENTRATION IN CENTRAL TUNISIA (EVOLUTION GEOCHIMIQUE DES EAUX ET DES SOLUTIONS INTERSTITIELLES AU COURS DE LEUR CONCENTRATION EN TUNISIE CENTRALE.

Centre de Recherche du Genie Rural, Tunis (Tunisia).

For primary bibliographic entry see Field 2K. W87-05118

SORPTION AND DESORPTION OF DE-GREASING CHLOROORGANICS WITH SUB-SURFACE SEDIMENTS, Missouri Univ.-Rolla. For primary bibliographic entry see Field 5B. W87-05140

EFFECTS OF CLAY MINERAL-ORGANIC MATTER COMPLEXES ON GASEOUS HY-DROCARBON EMISSIONS FROM SOILS, Radian Corp., Austin, TX. For primary bibliographic entry see Field 5B. W87-05141

2H. Lakes

VARIATION IN ABUNDANCE OF ZOO-PLANKTON IN KUIBYSHEV RESERVOIR IN CONNECTION WITH HYDROLOGICAL CON-DITIONS AND PHYTOPLANKTON QUANTITY.

TY, Akademiya Nauk (USSR). Institute of Ecology of the Volga Basin. A. F. Timokhina.

A. F. Innokania Soviet Journal of Ecology SJECAH, Vol. 17, No. 1, p 9-13, January-February 1986. 3 fig, 2 tab, 10 ref. Translated from Ekologiya, No. 1, p 12-17, January-February 1986.

Descriptors: *Hydrological regime, *Population density, *Reservoirs, *Limnology, *Kuibyshev Reservoir, *USSR, *Zooplankton, *Phytoplankton, *Water depth, Long-term studies, Rotifers, Cyclops, Temperature, Diatoms, Green algae, Bac-

Lakes-Group 2H

terioplankton, Seasonal variation, Trophic level, Biomass.

Biomass.

Data are presented and discussed regarding the interannual variations (1958-1983) in abundance of zooplankton in relation to the hydrologic regime and development of phytoplankton in kubbyshev Reservoir (USSR). Long-term fluctuations in zooplankton abundance depend on several factors. Most conspicuous was the negative association between zooplankton quantity and water level, which in some cases exceeded the effect of temperature and the trophic factor. Variations in water temperature have a great effect on the abundance of rotifers and cyclops, primarily the spring complex. The quantity of filter feeders corresponded positively with the presence of diatoms and green algae and bacterioplankton. The authors hypothesize that optimal conditions for development of zooplankton are created in warm, low-water years with high phytoplankton biomass and that unfavorable conditions occur in cool, high-water years with low abundances of bacteria and phytoplankton. (Rochester-PTT) W87-04379

RECORD ST. CLAIR RIVER ICE JAM OF 1984, National Oceanic and Atmospheric Administra-tion, Ann Arbor, MI. Great Lakes Environmental Research Lab.

For primary bibliographic entry see Field 2C. W87-04392

UREA METABOLISM AND ITS SIGNIFICANCE IN THE NITROGEN CYCLE IN THE EUPHOTIC LAYER OF LAKE BIWA: IV. REGENERATION OF UREA AND AMMONIA, Osaka Kyoiku Univ. (Japan). Lab. of Environon-mental Science and Education.
O. Mitamura, and Y. Saijo.
Archiv fuer Hydrobiologie AHYBA4, Vol. 107, No. 4, p 425-440, October 1986. 1 fig. 4 tab, 45 ref.

Descriptors: *Isotope studies, *Tracers, *Limnology, *Ureas, *Urea metabolism, *Nitrogen cycle, *Euphotic zone, *Ammonia, *Urea regeneration, *Ammonia regeneration, *Lake Biwa, Zooplankton, Excretion, Microbial degradation, Mineralization, Phytoplankton.

tion, Phytoplankton.

The regeneration rate of urea and ammonia from zooplankton excretion and microbial mineralization (microbial degradation in the case of urea) was measured in the in situ condition in the euphotic layer at two stations of Lake Biwa. The urea excretion and mineralization rate was calculated from the results of the urea decomposition experiment which used C14-labelled urea. The in situ assimilation rates of urea, ammonia and nitrogen were measured using a N15 tracer. The daily regeneration rate (sum of excretion and mineralization rate (sum of excretion and mineralization rate (sum of the contribution of the excretion rate in the regeneration rate ranged from 38 to 64% for urea and 55 to 76% for ammonia. Urea excretion in the total excretion rate (sum of urea and ammonia excretion) was 3 to 30% and the urea mineralization in the total mineralization area (sum of urea and ammonia excretion) was 10 to 45%. The average ratio of the daily regeneration rate to the daily assimilation rate by phytoplankton was 0.82 for urea and 1.18 for ammonia. The study indicated that the nitrogen supply from the excretion and mineralization through these processes was in a state of dynamic balance with the nitrogen consumption by phytoplankton assimilation, and the urea and ammonia were rapidly recycling in the euphotic layer of Lake Biwa. (Author's abstract)

AMINO ACIDS UPTAKE OF OSCILLATORIA RUBESCENS D. C. (BLUE GREEN ALGAE) (AS-SIMILATION DES ACIDES AMINES PAR OS-CILLATORIA RUBESCENS D. C. (CYANOPHY-

ut National de la Recherche Agronomique on-les-Brins (France). Inst. de Limonologi

For primary bibliographic entry see Field 5B. W87-04407

OBSERVATIONS ON THE POPULATION DY-NAMICS AND DISTRIBUTION OF THE WHITE PRAWN PALAEMON LONGIROSTRIS H. MILNE EDWARDS, 1837 (CRUSTACEA, DE-CAPODA, NATANTIA) IN THE NETHER-LANDS, WITH SPECIAL REFERENCE TO ITS OCCURRENCE IN THE MAJOR RIVERS,

Aquatic Ecology.
F. W. B. Van den Brink, and G. Van der Velde.
Archiv fuer Hydrobiologie AHYBA4, Vol. 107,
No. 4, p 465-495, October 1986. 26 fig, 2 tab, 53

Descriptors: *Cooling water, *Population dynamics, *White prawn, *Crustaceans, *Rhine River, *Meuse River, *Seasonal distribution, *Powerplants, *Estuarine environment, Netherlands, Freshwater, Migration, Reproduction.

From 1980 to 1982 the population-dynamics of five populations of Palaemon longirostris were studied by regular sampling of the cooling-water intakes of power stations situated in the freshwater region of the Dutch rivers Rhine and Meuse. There was a clear seasonal fluctuation in numbers at all stations. clear seasonal fluctuation in numbers at all stations. The low percentage of ovigerous females during breeding season and the absence of juveniles below the 20-25 mm size group suggested that the egg and/or larval development does not occur in the freshwater habitats but probably in the estuarine region of the rivers or in the North Sea. The distribution in The Netherlands showed that P. longirostris is an euryhaline species with a strong preference for meso- and oligohaline parts of the estuarine area. However, especially the females migrate upstream into the freshwater sections of the rivers and probably downstream for reproduction in the brackish estuarine areas. (Author's abstract) stract) W87-04408

RESOURCE PARTITIONING OF FOOD PARTICLES BETWEEN ASSOCIATED LARVAE OF PROSIMULIUM RUFIPES AND EUSIMULIUM CRYOPHILUM (DIPTERA, SIMULIDAE) IN AUSTRIAN MOUNTAIN BROOKS, Konstanz Univ. (Germany, F.R.). Fakultaet fuer Biologie.

For primary bibliographic entry see Field 2E. W87-04409

INFLUENCE OF SALINITY ON THE DISTRI-BUTION OF EGERIA DENSA IN THE VALDI-VIA RIVER BASIN, CHILE, Pontificia Univ. Catolica de Chile, Temuco. For primary bibliographic entry see Field 2L. W87-04410

COMMENTS ON FLUOROMETRIC CHLORO-PHYLL DETERMINATIONS IN THE FIELD, Hanover Univ. (Germany, F.R.). Inst. fuer Bio-For primary bibliographic entry see Field 7B. W87-04411

LIGNIN AND FIBER CONTENT OF FPOM GENERATED BY THE SHREDDERS TIPULA ABDOMINALIS (DIPTERA: TIPULIDAE) AND TALLAPERIA CORNELIA (NEEDHAM AND SMITH) (PLECOPTERA: PELTOPERLIDAE), Alabame Livis, University David & Biology,

SMIII) (FLECOTIERA: FELTOTE ENTAGEN, Alabama Univ., University. Dept. of Biology. G. M. Ward, and D. R. Woods. Archiv fuer Hydrobiologie AHYBA4, Vol. 107, No. 4, p 545-562, October 1986. 5 fig. 3 tab, 33 ref.

Descriptors: *Lignins, *Fibers, *Shredders, *Fine particle organic matter, *Leaves, Cranefly larvae, Stonefly nymphs, Cellulose, Cuticular tissues, Epidermis, Mesophyll tissues, Nutrients, Alkalinity, Feeding rates.

Lignin and fiber content of fine particle organic matter (FPOM) generated by the shredders Tipula abdominalis and Tallaperla cornelia from 6 leaf

types was compared with the initial content in whole leaves. The leaf packs were incubated from February to April 1984 in Yellow Creek, Alabama, February to April 1984 in Yellow Creek, Alabama, which is a second order stream low in alkalinity and nutrients. After being harvested and rinsed the leaves were placed in aquaria with cranefly larvae, stonefly nymphs or held as a control. Results indicated that the lignin and fiber content in FPOM from T. abdominalis was little changed from that in whole leaves. In contrast, FPOM generated by T. cornelia contained an average 30% less lignin and 50-67% less cellulose than did the whole leaves. This difference was attributed to selective feeding by T. cornelia on cuticle, epidermal and mesophyll tissues, and to a more extensive maceration of the leaf tissue. (Wood-PTT) W87-04412

STRESS-STRAIN STATE OF THE SAYANO-SHUSHENSKOE DAM DURING FILLING OF THE RESERVOIR,
For primary bibliographic entry see Field 8A.
W87-04413

PHYTOPLANKTON GROWTH AND PHOS-PHATE UPTAKE (FOR P LIMITATION) BY NATURAL PHYTOPLANKTON POPULA-TIONS FROM THE LOOSDRECHT LAKES (THE NETHERLANDS), Amsterdam Univ. (Netherlands). Lab. voor Micro-biologie.

For primary bibliographic entry see Field 5B. W87-04427

RECIPROCAL INTERACTIONS BETWEEN ROACH, RUTILUS RUTILUS, AND ZOO-PLANKTON IN A SMALL LAKE: PREY DYNAMICS AND FISH GROWTH AND RECRUIT-

MENT,
University of East Anglia, Norwich (England).
School of Biological Sciences.
M. Cryer, G. Peirson, and C. R. Townsend.
Limnology and Oceanography LIOCAH, Vol. 31,
No. 5, p 1022-1038, September 1986. 5 fig. 5 tab, 44

Descriptors: *Roach, *Zooplankton, *Fish growth, *Prey dynamics, *Predation, *Recruit-ment, Seasonal variation, Fry, Fish, Copepods, Ro-tifers, Daphnia, Diets, Cladocera, England, Lakes, Fertility, Species density.

It is now widely accepted that predation plays a critical role in determining zooplankton community structure in ponds and lakes. Highly selective predation by fish and zooplankton together determine which species of primary consumer can persist in limnetic regions and which are excluded or confined to refuges. Recruitment success of roach varied dramatically between 1979 and 1982 in Alderfen Broad, a small lake in eastern England. When fry were abundant (in 1979 and 1981, but not in 1980 or 1982) the summer zooplankton became sparse and was dominated by copepods and rotifers. In years of good recruitment, as each of the preferred cladoceran prey species entered the diet of underyearling roach, its density dropped dramatically. Mean size of Daphnia hyaof the preferred cladoceran prey species entered the diet of underyearling roach, its density dropped dramatically. Mean size of Daphnia hyalina and Ceriodaphnia quadrangula also declined significantly during these seasons. The results of enclosure experiments indicate that the link between roach recruitment and zooplankton dynamics is causal. Older roach also feed to a significant extent on zooplankton, but the 0+ age group exerted the greatest influence. The abundant underyearling roach in years of good recruitment showed poor growth, as a result of depression of their prey populations. Older fish also grew poorly in these years and were then less fecund in the following season. The evidence indicates that there may be a 2-year cycle in roach recruitment, and the unusual circumstances in Alderfen which may be responsible are described. (Alexander-PTT)

COMPETITION IN ZOOPLANETON COMMUNITIES: SUPPRESSION OF SMALL SPECIES BY DAPHNIA PULEX, Illinois Univ. at Urbana-Champaign. Dept. of

Group 2H—Lakes

Ecology, Ethology and Evolution. M. J. Vanni.

on. J. Vanni. Limnology and Oceanography LIOCAH, Vol. 31, No. 5, p 1039-1056, September 1986. 7 fig. 3 tab, 56 ref. Illinois Water Resources Center Grant S-093-ILL.

Descriptors: *Competing use, *Zoopiankton, *Daphnia, *Colonization, Phytoplankton, Eutrophic lakes, Nutrients, Species density, Crustaceans, Rotifers, Predation, Diets, Illinois, Lakes, Herbi-

Vores, Population density.

Freshwater zooplankton communities typically are dominated by either large or small-bodied species. Lakes containing abundant planktivorous fish contain mostly small species. The hypothesis that a large zooplankton herbivore, Daphnis pulez, can competitively reduce the abundance of resident zooplankton when colonizing a community of small species was tested in two lakes. When introduced to enclosures in estrophic Larimore Pond, D. Pulex decreased phytoplankton abundance by an order of magnitude, resulting in drastically reduced densities of Tropocyclops prasinus and Mesocyclops edax, the two dominant crustaceans in the pond. Daphnia pulex was also added to enclosures in oligo-mesotrophic Dynamite Lake, along with nutrients, in a factorial design. Three Dynamite Lake zooplankters were reduced in density by D. pulex under both enriched and unearched conditions: Bosmina longirostris, Trichocerca multicrinis, and copepod nauphii. Nutrient additions allowed these taxa to overcome some effects of competition with D. pulex. Daphnia pulex reduced the densities of coppeods and rotifers common to both lakes more in eutrophic Larimore Pond than in unenriched Dynamite Lake enclosures. These results show that a large herbivore can reduce the density of some small zooplankton species and therefore contribute to the scarcity of small species in lakes dominated by large herbivores. Purthermore, the results suggest that the competitive effects of a large herbivore on rotifers and copepods may be more pronounced in eutrophic systems because the large species can attain a higher population design, and the pulsar of the proposition density and subsequently alter the resource. rouse or a large nerouvore on rottlers and copepods may be more pronounced in eutrophic systems because the large species can attain a higher popu-lation density, and subsequently alter the resource base to a greater extent, in eutrophic systems. (Alexander-PTT)

DIEL EPIBENTHIC ACTIVITY OF MAYFLY

NIEL EPIBENTHIC ACTIVITY OF MAYFLY
WYMPHS, AND TIS NONCONCORDANCE
WITH BEHAVIORAL DRIFT,
Maryland Univ., College Park. Dept. of Zoology.
J. Allan, A. S. Flecker, and N. L. McClintock.
Limnology and Oceanography LIOCAH, Vol. 31,
No. 5, p 1057-1065, September 1986. 3 fig. 3 tab, 34
ref. NSF Grant BSR 82-14487.

Descriptors: *Diel epibenthic activity, *May flies *Nymphs, *Drift activity, *Streams, Substrates Light quality, Temperature, Foraging, Downstream, Aquatic insects, Temporal variation.

The downstream transport of organisms in rivers, termed drift, has been the subject of many studies. Particular attention has been focused on the pronunced diel rhythm in the drift activity of crustanounced manufacture insects, which typically exhibit rarticular attention has been locused on the pronounced diel rhythm in the drift activity of crustaceans and immature insects, which typically exhibit
low daytime activity, a sharp increase in numbers
drifting just after dark, and a high but variable
level of drift during the hours of darkness. Diel
changes in the numbers and activity of mayfly
(Ephemeroptera) nymphs on the substrate surface
in a stony-bottom stream were determined by
direct observations, to investigate the relationship
between benthic activity and drift. Individuals
were viewed through a glass box (0.1 sq m area) at
2-h intervals for 24 h; dim red light was used
during darkness. Baetis was relatively unaffected
by the presence of the observer, whereas Cinygmula was very easily disturbed. The number of
individuals in view, activity per individual, and
total activity all were greatest by day and least
during the night for both species. Each of these
measures was significantly correlated with temperature, which varied 6-8 C over the diel cycle. Drift
activity, in contrast, was strongly nocturnal and activity, in contrast, was strongly nocturnal and generally peaked immediately after nightfall. Be-cause of the clear lack of correspondence between drift and the activity of mayfly nymphs on stone

tops, behavioral drift in this system cannot be explained as the passive consequence of foraging. (Alexander-PTT) W87-04430

LITTORAL SLOPE AS A PREDICTOR OF THE MAXIMUM BIOMASS OF SUBMERGED MACROPHYTE COMMUNITIES, McGill Univ., Montreal (Quebec). Dept. of Biol-

ogy. C. M. Duarte, and J. Kalff. Limnology and Oceanography LIOCAH, Vol. 31, No. 5, p 1072-1080, September 1986. 2 fig. 4 tab, 46

Descriptors: *Littoral alope, *Biomass, *Macc phytes, *Submerged plants, *Mathematical mode Littoral zone, Lakes, Sediments, Mathematic equations, Turbidity, Prediction, Aquatic plan Morphometry, Organic matter.

Morphometry, Organic matter.

Submerged aquatic macrophytes play a major role in the dynamics of shallow lakes and the littoral zone of many large lakes. Their abundance influences the trophic status and phytoplankton biomass levels of shallow lakes. Their suffaces provide a substrate for readily grazeable epiphytes and their abundance affects fish population. The hypothesis that the morphometric characteristics of the littoral zone of lakes are a major determinant of submerged macrophyte biomass was tested in Lake Memphremagog (Quebec-Vermont) by studying the relationship between maximum biomass of submerged macrophytes and physical and sediment characteristics of the littoral zone. The slope of the littoral zone accounted for 72% of the observed variability in maximum submerged macrophyte biomass (MSMB). By also incorporating sediment organic matter the variance explained was raised to 88% (P <0.0001). A model based on only slope as predictor of MSMB was improved by considering slopes > 0 < 5.33% islope < 5.33% MSMB (g fresh wt/sq m) = -29.8 + 1.403 slope to the -0.81 power; slope > 5.33% mSMB (g fresh wt/sq m) = 13.2 + 3.434 slope to the -0.81 power; slope > 5.35% mSMB (g fresh wt/sq m) = 9.0.0001). However, the temperate zone model overestimates the MSMB in highly turbid lakes where irradiance rather than slope is pre-eminent and underestimates the biomass in semi-tropical and tropical lakes. (Alexander-PTT)

CALCITE PRECIPITATION IN LAKE CON-STANCE: CHEMICAL EQUILIBRIUM, SEDI-MENTATION, AND NUCLEATION BY ALGAE, Konstanz Univ. (Germany, F.R.). Limnological

Limnology and Oceanography LIOCAH, Vol. 31, No. 5, p 1081-1093, September 1986. 8 fig. 2 tab, 43 ref. Deutsche Forshungsgemeinschaft DFG Az: Ti 115/2.

Descriptors: *Chemical precipitation, *Sedimenta-tion, *Nucleation, *Calcite, *Algae, *Chemical equilibrium, *Lakes, Seasonal variation, Solutes, Lake Constance, Supersaturation, Titanium, Trac-ers, Sediments, Zones, Nutrients.

ers, Sediments, Zones, Nutrents.

Autochthonous formation and subsequent precipitation of calcium carbonate is an important process in the carbon and calcium cycling in many hard waters. Through coprecipitation calcium carbonates affect nutrient budgets and by adsorption they remove dissolved organic carbon (DOC) from the water. Seasonal shifts in calcium carbonate solution equilibria in the limnetic zone of Lake Constance were documented between 1981 and 1983. Except during mixing times, lake water was supersaturated with respect to calcite; epilimnetic supersaturated with respect to calcitum from the lower boundary of the euphotic zone to the lake bottom was also assessed. The daily sedimentation flux for calcium during the season varied over three orders of magnitude. Differences in the calcium content of sediments trapped at various depths were insignificant. Sedimentation rates of titanium were used as tracers for the fluxes of calcium bound on

allochthonous clastic material. Lacustrine calcite precipitation (39-49% of the total sedimentation rate) was obtained by subtracting fluxes of alcoththonous Ca from the rates of total Ca sedimentation. Calcium supersaturation maxima were not in phase seasonally with maximum fluxes of sutochthonous Ca. Instead, calcite precipitation was associated with the occurrence of Stephanodiscus hantzeshii, Fragiliaria crotonensis, Asterionella formosa, Chlorella sp., Pandorina morum, and Mougetia thylespora, indicating that calcite formation was triggered by heterogeneous nucleation induced by certain algal species. (Alexander-PTT) W87-04432

HORIZONTAL SEDIMENTATION DIFFER-ENCES IN A EUTROPHIC SWISS LAKE, Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewesserschultz, Due-bendorf (Switzerland). Inst. of Aquatic Sciences. J. Bloesch, and U. Uehinger. Limnology and Oceanography LiOCAH, Vol. 31, No. 5, p 1094-1109, September 1986. 12 fig. 3 tab, 45 ref.

Descriptors: *Sedimentation, *Eutrophic lakes, *Lake Hallwil, Organic carbon, Nutrients, Phosphorus, Biomass, Littoral zone, Profundal zone, Zones, Seasonal variation, Deposition, Suspension, Metabolism, Lakes.

Metabolism, Lakes.

Sedimentation is one of the fundamental processes governing lake metabolism by influencing epilimentic rutrient regeneration, removing particulate matter to the bottom, and controlling nutrient supply to benthic animals. Although the theoretical sepects of sinking mechanisms of particles are complex and poorly understood, data on bulk particle flux provide insight into the lake ecosystem. Settling fluxes measured by means of sediment traps were 887 g dry wt/sq m/y, 113 g POC /sq m/y and 2.6 g PP /sq m/y in 1982-1983 at a central station in eutrophic Lake Hallwil, Switzerland. Nearshore settling rates were higher by a factor of 1.4-3.4. Since particulate organic carbon (POC), particulate phosphorus (PP), and biomass concentration in the lake water showed vertical rather than horizontal differences, this result was attributed to permanent bottom sediment resuspension and redeposition in the littoral zone. Horizontal sediment transport (sediment focusing) and sediment resuspension in the profundal zone in winter, when wind and turbulence are increased, accounted for only about 20% of the sedimentation for the year occurred during summers, such processes are of minor importance in Lake Hallwil, although a 'nepheloid' layer with increased POC and PP concentrations 5-8 m above the bottom was present. It is stressed that the mechanisms of sediment transport must be known to permit interpretation of trap results and to understand lake metabolism. (Alexander-PTT)

FALLOUT PLUTONIUM IN TWO OXIC-ANOXIC ENVIRONMENTS, Washington Univ., Seattle. School of Oceanography. For primary bibliographic entry see Field 5B. W87-04434

FILTERING ACTIVITY OF DAPHNIA IN LOW CONCENTRATIONS OF A PESTICIDE, Warsaw Univ. (Poland). Dept. of Hydrobiology. For primary bibliographic entry see Field 5C. W87-04435

SEASONAL COMMUNITY STRUCTURE AND DRIFT OF MICROCRUSTACEANS IN VALLEY CREEK, MINNESOTA, Brigham Young Univ., Provo, UT. Dept. of Zool-

ogy. D. K. Shiozawa. Canadian Journal of Zoology CJZOAG, Vol. 64, No. 8, p 1655-1664, August 1986. 5 fig. 4 tab, 48

Descriptors: *Lotic environment, *Seasonal varia-tion, *Drift rates, *Microcrustaceans, *Streams,

*Population density, *Copepods, *Cladocera, Benthic fauna, Valley Creek, Minnesota, Deposi-tion, Erosion, Silting, Sedimenta, Aquatic habitata, Detritus, Ponds, Littoral zone.

Lotic systems that have resident zooplankton populations are usually larger rivers, and the zooplankton include many of the same species found driftulations are usually larger rivers, and the zooplankton include many of the same species found drifting from lentic environments. These zooplankton
are thought to originate in backwater areas or
through the continual drift from lentic waters.
Although some recognition of a possible lotic
beathon source is present in the literature, researchers usually assume this to be misnor or temporary
and few stream studies have attempted to locate
resident benthic microcrustaceans. The seasonal
abundance of copepods and cladocerans found in
Valley Creek, Washington County, Minnesota was
examined. Both benthic densities as well as drift
rates were quantified. A total of 16 species was
collected in quantitative benthic samples and two
additional species occurred in drift samples. The
Valley Creek microcrustaceans could be classified
into two general groups, those residing in depositional stream habitats similar to a lake or pond
littoral and favoring an epibenthic lifestyle, and
those found in more erosional habitats where a
hyporheci lifestyle is more likely. The microcrustacean community also demonstrated a distinct seasonality with peak abundance in the spring and
early summer. Sediment size composition also
demonstrated a seasonal change but detrital couposition did not. Microcrustacean drift generally
paralleled changes in benthic density but in several
demonstrated a seasonal shape but detrital couposition did not. Microcrustacean drift generally
paralleled changes in the
benthoa. This lag could be due to a seasonal sitution of the sediments, which would compress in the
benthoa. This lag could be to interstitial meiofounal
elements. (Alexander-PTT)

EFFECT OF SHORT-TERM ACIDIFICATION DURING SPRING SNOWMELT ON SELECT-ED MOLLUSCA IN SOUTH-CENTRAL ON-

TARIO, Guelph Univ. (Ontario). Dept. of Zoology. For primary bibliographic entry see Field Sc. W87-0455.

REPRODUCTION OF A FINGERNAIL CLAM IN CONTRASTING HABITATS: LIFE-HISTO-RY TACTICS,

RY TACTICS, Guelph Univ. (Ontario). Dept. of Zoology. R. C. Bailey, and G. L. Mackie. Canadian Journal of Zoology CJZOAG, Vol. 64, No. 8, p 1701-1704, August 1986. 3 fig. 1 tab., 23 ref. NSERC (Canada) Operating grant A9882.

Descriptors: *Reproduction, *Clams, *Aquatic abitats, *Life history studies, *Ponds, *Population ynamics, *Lakes, *Mathematical models, Predic-on, Population density, Evolution, Comparison

studies.

It has been argued that the detection of different life-history tactics (e.g., timing, amount, and frequency of reproduction) within a species is extremely unlikely. Allometric and developmental constraints prevent the free-floating' coadaptation of life-history traits to different optima in different environments. Studies of freshwater fingernail clams (Bivalvia: Pisidiidae), however, show large intraspecific variation in litter size among habitat types. In a population of a semelparous fingernail clam (Pisidium casertanum) inhabiting an ephemeral pond, litter size was larger and generation time was shorter than that of a conspecific population in a lake. This agreed with the r-K selection model, which predicts selection for a shorter generation time and larger litter sizes in relatively unstable habitats. Cage experiments at varying densities, however, revealed that considerable phenotypic variability in litter size may be environmentally induced. These results indicate that this and other comparative studies of jutraspecific variation in the life-history traits of fingernail clams cannot conclude that varying evolutionary tactics are present until simpler hypotheses of environmentally induced variation are dismissed. (Alexander-PTT) W87-04455

POPULATION BIOLOGY OF CULAEA IN-CONSTANS, THE BROOK STICKLEBACK, IN A SMALL PRAIRIE LAKE, Winnipeg Univ. (Manitoba). Dept. of Biology. G. E. Moodie. Canadian Journal of Zoology CIZOAG, Vol. 64, No. 8, p 1709-1717, August 1986. 2 fig. 6 tab, 42

Descriptors: *Population dynamics, *Biology, *Culaea, *Stickleback, *Prairie lakes, *Fish, *Lakes, Reproduction, Morphology, Monitoring, Growth, Diets, Spawning, Migration, Aquatic habitats, Predation, Fish eggs.

Several morphological analyses of the monospecific genus Calaea inconstans over fairly broad geographic areas allow a comparison of variability in
his species and Gasterosteus aculeatus. While
some populations are polymorphic in the development of the pelvic girdle and all are polymorphic
in the number of dorsal spines and some characters
exhibit broad clines. Calaea does not exhibit the
geographical and ecotypic differentiation that justfies the terms species complex and superspecies,
which are useful to deal with the great variation
found in G. aculeatus. Density, female reproductive effort, diet, and morphology of a population of
Culaea inconstans were monitored over a 4-year
period. Density varied from near extinction to 2.4
fish/sq m. There was evidence that growth and
female reproductive effort were inversely correlated with density. Females may spawn every 3 days
when food is abundant. Fecundity ranged from 104
eggs per female when density was greatest, to 451
eggs per female the year density was lesst. The
species is capable of large scale prespawning migrations, which may result in an immigrant to
resident ratio of 0.5-8.1, depending on resident
density. Regular immigration couppying unstable
habitats may account for the apparent lack of local
morphological adaptation which seems to characterize this species. Despite substantial variation in
density, significant variation in annual growth, and
different levels of predation, there was no important variation in gill raker means or the number of
dorsal and pelvic spines over the course of the
study. (Alexander-PlTT)
W87-04456

DIFFERENTIAL TEMPERATURE SENSITIVI-TY OF TWO CLADOCERAN SPECIES TO RE-SOURCE VARIATION DURING A BLUE-GREEN ALGAL BLOOM, Oklahoma Univ., Kingstoe. Biological Station. S. T. Threlkeld. Canadian Journal of Zoology CIZOAG, Vol. 64, No. 8, p 1739-1744, August 1986. 5 fig. 1 tab, 32 ref. NSF Grant DEB 8022163.

Descriptors: *Temperature effects, *Cladocera, *Eutrophicatios, *Cyanophyta, *Water pollution effects, *Differential sensitivity, *Reservoirs, *Zooplankton, Growth rates, Life history sudies, Population density, Seasonal variation, Species composition, Reproduction, Algae, Incubation.

composition, Reproduction, Algae, Incubation.

Although interactions of resource and temperature variation have recently received some attention, these studies have generally failed to advance the view that such interactions are important except in a broad seasonal content because the range of conditions examined (5-10 C increments, logarithmic increments in resources) do not fairly represent natural variation in temperature or resource conditions occurring on shorter time scales. When equation organism are fully acclimated, however, it appears that physiological processes are insensitive to limited variability in temperature and resource conditions. The sensitivity of life-table parameters of two cladoceran zooplankton to slight, natural variations in temperature was determined during the onset of a midsummer blue-green algal bloom in a large turbid reservoir (Lake Texona, Okiahoma, Texas). Prior to the onset of blue-green algae, cohorts of Ceriodaphnia lacustris incubated at ambient epilimnion temperatures (27-30 C) had higher individual somatic and population growth rates, an earlier age at first reproduction, and shorter lifespans than cohorts incubated at a constant 25 C. As blue-green algae became abundant, Ceriodaphnia

growth rates were reduced more dramatically at ambient temperatures than at 25 C, suggesting that a temperature-resource interaction was important to determination of somatic growth rate, age of first reproduction, and population growth rate. Ceriodaphnia populations declined in Lake Texoma as blue-green algae became abundant. Disaphanonoma leuchtenbergianum, which was abundant throughout the period of blue-green algal dominance, did not show the temperature-resource interaction have been hypothesized to determine seasonal change in zooplankton community structure; this study provides experimental evidence of demographic consequences in natural populations of one kind of common temperature-resource interaction. (Alexander-PTT) W87-04457

DENITRIFICATION IN MARL AND PEAT SEDIMENTS IN THE FLORIDA EVER-GLADES,
Old Dominion Univ., Norfolk, VA. Dept. of Biological Sciences.
A. S. Gordon, W. J. Cooper, and D. J. Scheidt.
Applied and Environmental Microbiology
AEMIDF, Vol. 52, No. 5, p 987-991, November 1986. 4 fig. 1 tab, 22 ref.

Descriptors: "Fate of pollutants, "Path of pollutants, "Denitrification, "Marl, "Pest, "Sediments "Florida Everglades, "Nitrates, Temperature, Sugars, Phosphates, Nutrients, Ammonium, Concentration, Watersheda, Wetlands, Shark River Slough, Everglades, Florida.

centration, Watersheds, Wetlands, Shark River Slough, Everglades, Florida.

The flow of water from Lake Oksechobe through the open glades is a natural feature of the Everglades ecosystem, which has been grossly modified by a system of canala and levees designed for flood control and water distribution. The water distribution scheme, at present, is a system of canala, control structures, and pumping stations which supply water to the dikad water conservation areas and the Everglades National Park (ENF). The northers reaches of this system are the site of heavy agricultural activity and correspondingly eutrophic waters. These waters, flowing south through the canala, are purified somewhat on route but still retain nutrient levels above those of Everglades marsh water. The potential for denitrification in and past sediments in the Shark River Slough in the Everglades National Park was determined by the acetylence blockage assay. The influence of nitrate concentration on denitrification rate and N2O yield from added nitrate was examined. The effects of added glucose and phosphate and of temperature on the denitrification potential were determined. The sediments readily desirtified added nitrate. N2O was released from the sediments both with and without added acetylene. The mart sediments had higher rates than the peat on every date sampled. Denitrification was nitrate limited: however, the yields of N2O amounted to only 10 to 34% of the added nitrate when 100 microM nitrate was added. On the basis of measured increases in ammonium concentration, it appears that the balance of added nitrate when 100 microM nitrate was added. On the basis of measured increases in ammonium concentration, it appears that the balance of added nitrate when 100 microM nitrate was added. On the basis of measured increases in ammonium concentration, it appears that the balance of added nitrate when 100 microM nitrate was added. On the basis of measured increases in ammonium concentration, it appears that the balance of added nitrate may be

DEPTH DISTRIBUTION OF BACTERIAL PRO-DUCTION IN A STRATIFIED LAKE WITH AN ANOXIC HYPOLIMNION, Georgia Univ., Athens. Dept. of Zoology. R. J. McDonough, R. W. Sanders, K. G. Porter, and D. L. Kirchman.

Group 2H—Lakes

Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 5, p 992-1000, November 1986. 7 fig, 3 tab, 39 ref. NSF Grant BSR-8407928.

Descriptors: *Limnology, *Bacteria, *Productivity, *Stratified lakes, *Anoxia, *Hypolimnion, *Anaerobic conditions, *Biomass, *Water pollution effects, *Isotope studies, Population density, Inhibition, Proteins, Depth profiles, Amino acids, Metabolism, Metalimnios, Epilimnion.

tion, Proteina, Depth profiles, Amino acids, Metabolism, Metalimnico, Epilimnion.

The thymidine approach has been instrumental in demonstrating the importance of bacterioplankton in the trophic dynamics of aquatic systems. Several studies have used thymidine incorporation to estimate bacterial production and have found that bacterial production in often high (10 to 50%) compared with primary production in marine systems. The depth distribution of bacterial biomass and production in a stratified lake were determined and techniques to measure bacterial production in assacrobic waters were tested. Bacterial abundance and incorporation of both (3H)thymidine and (3H)tleucine into protein were highest in the metalismion, at the depth at which oxygen first became unmeasurable. In contrast, (3H)thymidine incorporation into DNA was highest in the epilimnion. The ratios of incorporation into DNA protein averaged 2.2, 0.49, and 0.95 for the epilimnion, metalismico, and hypolimnion, respectively. Low incorporation into DNA was not due to artifacts associated with the DNA isolation procedure. Recovery of added (3H)DNA was about 90% in waters in which the portion of (3H)thymidine incorporation waters substantially inhibited thymidine incorporation waters substantially inhibited thymidine incorporation and the frequency of dividing cells were all similar, with maximal rates in the metalismion. However, estimates of bacterial production estimated from total thymidine and leucine incorporation were usually significantly higher than estimates based on thymidine incorporation waters substantially inhibited thymidine incorporation and the frequency of dividing cells and leucine incorporation were usually significantly higher than estimates based on thymidine incorporation incorporation waters substantially inhibited thymidine incorporation and the frequency of dividing cells and leucine incorporation and the frequency of dividing cells and leucine incorporation and the frequency of dividing cells and leucine incorporation and the

METABOLISM OF REDUCED METHYLATED SULFUR COMPOUNDS IN ANAEROBIC SEDI-MENTS AND BY A PURE CULTURE OF AN ESTUARINE METHANOGEN, State Univ. of New York at Stony Brook. Marine Sciences Research Center. For primary bibliographic entry see Field 2L. W87-04461

MANGANESE OXIDATION BY SPORES AND SPORE COATS OF A MARINE BACILLUS SPECIES, Leiden Rijksuniversiteit (Netherlands). Por primary bibliographic entry see Field 2K. W87-04462

MICROBIAL IRON REDUCTION BY ENRICH-MENT CULTURES ISOLATED FROM ESTUA-RINE SEDIMENTS, New Hampahire Univ., Durham. Jackson Estuarine Lab. J. B. Tugel, M. E. Hines, and G. E. Jones. Applied and Environmental Microbiology

rine Lab.
J. B. Tagel, M. E. Hines, and G. E. Jones.
Applied and Environmental Microbiology
AEMIDF, Vol. 52, No. 5, p 1167-1172, November
1986. 7 fig, 31 ref. NSF Grant OEE82-14863.

Descriptors: *Microbial processes, *Iron, *Reduction, *Cultures, *Sediments, *Estuaries, Isolation, Sulfates, Inhibition, Nitrates, Growth, Enzymes, Heavy metals, Cells, Oxidation.

Terminal decomposition processes in marine sedimentary environments have received considerable

attention recently. In particular, SO4(2-) reduction, methanogenesis, and the reduction of inorganic mitrogen are important anaerobic processes in sediments. They vary in their magnitude, depending on the availability of electron acceptors and organic matter. Geochemical studies have demonstrated that the vertical zonation of biogeochemical processes in sediments includes regions of Mn and Fe reduction. Sufficient free energy may be generated from these reductions to support microbial growth. Microbial Fe reduction in acetate- and succinate-containing enrichment cultures initiated with an estuarine sediment inoculum was studied. Fe reduction was unaffected when SO4(2-) reduction was inhibited by MoO4(2-), indicating that both processes could occur independently. Bacterially produced sulfide precipitated as Fes but was not completely responsible for Fe reduction. The separation of oxidized Fe particles from bacteria by dialysis tubing demonstrated that direct bacterial contact was necessary for Fe reduction. Fe reduction in cultures amended with NO3(-) was delayed until NO3(-) and NO2(-) were removed. However, bacterial attachment to oxidized Fe particles in NO3(-)-amended cultures occurred early during growth in a manner similar to NO3(-)-free cultures. During late stages of growth, bacteria not attached to Fe particles became pale and swollen, while attached cells remained bright blue when examined by 4',6-diamidine-2-phenylindole epifluorescence microscopy. The presence of added oxidized Mn had no effect on Fe reduction. The results suggested that enzymatic Fe reduction was responsible for reducing Fe in these cultures even in the presence of sulfide and that cells incapable of Fe reduction became unhealthy when Fe(III) was the only available electron acceptor. (Alexander-PTT)

STIMULATION OF BACTERIAL DNA SYN-THESIS BY ALGAL EXUDATES IN AT-TACHED ALGAL-BACTERIAL CONSORTIA, Montana State Univ., Bozeman. Dept. of Microbi-

ology. R. E. Murray, K. E. Cooksey, and J. C. Priscu. Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 5, p 1177-1182, November 1986. 2 fig, 1 tab, 52 ref. NSF Grant BSR-8500849.

Descriptors: *DNA synthesis, *Algae, *Bacteria, *Metabolism, *Substrates, *Diatoms, Growth population density, Organic carbon, Nutrients, Biofilms, Amino acids, Isotope studies.

Consortia composed of attached microalgal and bacterial populations have essential roles in aquatic ecosystems, acting as aitse of active nutrient regeneration and serving as a trophic resource for other organisms. Attached biofilm communities are also predominant in industrial aquatic systems in which microbial fouling is associated with corrosion and reduces the efficiency of industrial processes. Algal-bacterial consortia attached to polystyrene surfaces were prepared in the laboratory by using the marine diatom Amphora coffeaeformis and the organisms were attached to the surfaces at cell densities of approximately 50,000 cells /sq cm (diatoms) and 5,000,000 cells /sq cm (diatoms) and 6,000,000 cells /sq cm (diatoms) and consortia consortia consistently exhibited higher rates of (3H)thymidine incorporation by the algal-bacterial consortia were fourfold greater than the rates of incorporation by monobacterial biofilms 16 h after biofilm formation. Extracellular material released from the attached Amphora cells supported rates of bacterial activity (0.8 x 10 to the minus 21st power to 17.9 x 10 to the minus 21st power to 17.9 x 10 to the minus 21st power mol of (3H)thymidine incorporated/cell/h) and growth (doubling time, 29.5 to 1.4 days) comparable to values reported for a wide variety of marine and freshwater ecosystems. In the presence of sessile diatom populations, DNA synthesis by attached V. proteolytica cells was light dependent and increased with increasing algal abundance

W87-04464

FURTHER VERIFICATION OF THE ISOTOPE DILUTION APPROACH FOR ESTIMATING THE DEGREE OF PARTICIPATION OF (3H)THYMIDINE IN DNA SYNTHESIS IN STUDIES OF AQUATIC BACTERIAL PRODUCTION,

Uppsala Univ. (Sweden). Limnologiska Institutionen. R. T. Bell.

Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 5, p 1212-1214, November 1986. 4 fig, 21 ref. SNV Grant 5333195-5.

Descriptors: *DNA synthesis, *Isotope studies, *Amino acids, *Aquatic bacteria, *Productivity, *Metabolism, Isotope dilution, Inhibition, Growth rates, Bacteria.

rates, Bacteria.

The growth rate of heterotrophic bacteria in aquatic systems can be estimated by measuring the rate of incorporation of radiolabeled thymidine into DNA. Unless the concentration of (3H)thymidine maximizes the degree of participation(DP) of (3H)thymidine in DNA synthesis, the measured rates of DNA synthesis will be influenced by variation in the amount of dTMP produced via the de novo pathway. In general, a concentration of (3H)thymidine of 5 to 10 nM has proved sufficient for many aquatic environments. In other cases, a concentration of (3H)thymidine in DNA synthesis. A number of investigators have used a 5 nM (3H)thymidine addition without performing kinetic studies to determine the DP of this concentration. The optimal concentration of (3H)thymidine as determined by adding increasing amounts of labeled thymidine at the same specific activity was similar to the concentration of thymidine inhibiting the de novo pathway as determined by isotope dilution plots. These experiments provide further verification of the isotope dilution approach for determining the degree of participation of (3H)thymidine in DNA synthesis. (Alexander-PTT)

SUSPENDED CLAY CONCENTRATION CONTROLLED BY FILTER-FEEDING ZOOPLANKTON IN A TROPICAL RESERVOIR, Warsaw Univ. (Poland). Dept. of Hydrobiology.

M. Z. Gliwicz. Nature NATUAS, Vol. 323, No. 6086, p 330-332, September 25, 1986. 2 fig, 2 tab, 15 ref.

Descriptors: *Suspended solids, *Clays, *Zooplankton, *Reservoirs, *Aquatic environment, *Lakes, *Hydrology, *Seasonal variation, *Turbidity, *Mixing, Solids, Environment, Photosynthesis, Primary productivity, Light penetration, Nutrients, Flooding, Stratification, Plankton, Distribution, Monthly distribution, Predation, Productivity.

Clay suspended in lake water may be an important factor in limiting primary production by decreasing availability of light and nutrients. Seasonal changes in the concentration of suspended clay in a lake or a reservoir are usually attributed to the periodicity in hydrological events such as flooding, stratification, and mixing. However, data from Cahora Bassa, a large reservoir in Mozambique, show that filter-feeding zooplankton are also important in determining the seasonality of clay abundance. Cladoceran filter feeding results in the multiplication of settling velocity of clay material bound into clumps, decreasing clay concentration in the lake water. This is confirmed by a microscopic estimation of the clay-load volume in cladoceran intestines, combined with the estimation of the duration of food passage; the concentration of clay aggregates in the lake at different dates and depths, and the dry weight of sediment collected in sedimentation traps. Also, monthly, predator-induced periodicities in the density of zooplankton are synchronized with the periodicities in the rate of decrease in the clay-induced turbidity of the surface waters. (Author's abstract)

USE OF FRESHLY PREPARED RAT HEPATO-CYTES TO STUDY TOXICITY OF BLOOMS OF THE BLUE-GREEN ALGAE MICROCYSTIS AERUGINOSA AND OSCILLATORIA AGARD-

Norges Veterinaerhoegskole, Oslo. Dept. of Food Hygiene. For primary bibliographic entry see Field 5C. W87-04536

PRODUCTION OF NH4(+) BY THE SHRIMP CRANGON CRANGON L. IN TWO SLOPING BED ECOSYSTEMS. EXPERIMENTAL APPROACH AND STUDY OF THE INFLUENCE OF SEDIMENT ON THE EXCRETION RATE (PRODUCTION D'NH4(+) PAR LA CREVETTE CRANGON CRANGON L. DANS DEUX ECOSYSTEMES COTIERS. APPROCHE EXPERIMENTALE ET ETUDE DE L'INFLUENCE DU SEDIMENT SUR LE TAUX D'EXCRETION), Centre d'Études d'Oceanographie et de Biologie Marine, Roscoff (France).

SEDIMENT SUR LE TAUX D'EXCRETION), Centre d'Etudes d'Occanographie et de Biologie Marine, Roscoff (France). M. Regnault. Journal of Experimental Marine Biology and Ecol-ogy, JEMBAM, Vol. 100, No. 1-3, September 1986. 4 fig. 1 tab, 41 ref. CEE Contract AZOC-ENV825F.

Descriptors: *Seasonal variation, *Shrimp, *Excretion, *Ammonia, *Sediments, Flux, Littoral ecosystems, Sand, Mud.

Estimation of the ammonia production of the shrimp Crangon crangon in two littoral ecosystems (oligotrophic sand and eutrophic mud) was determined in winter and summer conditions from laboratory observations in experimental microcosms. The ammonia excretion rate of C. crangon was not influenced by either the sediment type or the ammonia concentration of the overlying water; on the influenced by either the sediment type or the ammonia concentration of the overlying water; on the other hand, the mean excretion rate and the response to initial handling stress increased markedly as ahrimp were deprived of soft substratum. The daily ammonia production of C. crangon was 16 micromol NH3/g wet wt/day in winter and 40 micromol NH3/g wd/day and 300-700 micromol of 12 micromol NH3/sq m/day and 300-700 micromol / sq m/day, respectively, could be expected in the two ecosystems studied. This would account for 5% (winter) and 2-4% (summer) of the total NH4(+) flux at the sediment-water interface. The contribution of the excretion of all macrofauna to the NH4(+) flux from the sediment is discussed. (Author's abstract) (Author's abstract) W87-04544

RESPONSES OF THE LOBELIA-EPIPHYTE COMPLEX TO LIMING OF AN ACIDIFIED

Lund Univ. (Sweden). Dept. of Ecology. For primary bibliographic entry see Field 5G. W87-04547

85-YEAR HISTORY OF THE AQUATIC MA-CROPHYTE SPECIES COMPOSITION IN A EUTROPHIC PRAIRIE LAKE (UNITED

Inwa Cooperative Fishery Research Unit, Ames. P. E. Niemeier, and W. A. Hubert. Aquatic Botany AQBODS, Vol. 25, No. 1, p 83-89, August 1986. 1 tab, 14 ref.

Descriptors: *Comparison studies, *Aquatic plants, *Species composition, *Species diversity, *Macrophytes, *Clear Lake, *Limnology, *Eutrophication, *Lakes, Phytoplankton, Surveys, Turbidity,

The results of seven aquatic vegetation surveys on Clear Lake, Iowa, between 1896 and 1981 were compared. Transects perpendicular from shore to the outer boundary of the vegetation zone were established at 20-m intervals in July and 40-m intervals in August. Vegetation was evaluated in 1-sq m quadrats at each interval by surface observation and by removal of plants within the water column for identification at the surface. Of 52 aquatic macrophyte species previously identified from the lake, 19 were found in 1981. Five species were reported for the first time. The species com-

position has shifted from one dominated by sub-mergent plants to one dominated by emergent plants. The changes over the past 85 years may be at least partially related to increased phytoplank-ton turbidity in recent years. (Main-PTT) W87-04548

FISH COMMUNITY STRUCTURE RESPONSE TO MAJOR HABITAT CHANGES WITHIN THE LITTORAL ZONE OF AN ESTUARINE

THE LITTORAL ZONE OF AN ESTUARINE COASTAL LAKE, Rhodes Univ., Grahamstown (South Africa). Inst. of Freshwater Studies.

A. K. Whitfield.
Environmental Biology of Fisher EBETTAL

Environmental Biology of Fishes EBFID3, Vol. 17, No. 1, p 41-51, September 1986. 3 fig, 3 tab, 24

Descriptors: *Species composition, *Population dynamics, *Species diversity, *Fish communities, *Habitat changes, *Littoral zone, *Estuarine lake, Turbidity, Swartvlei, South Africa, Water transparency, Solar radiation, Precipitation, Plant growth, Temperature, Salimity, Dissolved oxygen.

The littoral environ nent and fish fauna of Swartv-The littoral environment and fish fauna of Swartvei, was monitored for four years during which major habitat changes occurred. Stations were situated approximately 40, 70, 100, and 150 m from shore. Salinity, dissolved oxygen and temperature, pH, and water transparency were measured. Precipitation and solar radiation were measured with a shore. Saimity, accessived oxygen and temperature, pH, and water transparency were measured. Precipitation and solar radiation were measured with a rainguage and radiation integrator respectively. The growth cycle pattern of Potamogeton was monitored along a 1.5 m depth transect parallel to the gill net site by measuring the height of 100 plants each month. Initially the zone was dominated by Potamogeton pectinatus, Charaglobularis, and Lamprothamnium papulosum. This plant community was replaced by filamentous algal mats during 1980, and with the disappearance of these mats in 1981 the littoral zone was transormed into a sandy habitat. There was a significant decline in the numbers of fishes in the littoral zone between the macrophyte and sand phases but no significant decrease in fish biomass. Gill net catches revealed an in increase in the catch per unit effort (CPUE) of vegetation associated species over the same period. The three fish species diversity indices showed minor fluctuations between the habitat phases. The numbers of fish species during the macrophyte, algal mat, and sand phases varied less than 20%. The resilience of estuarine fishes to environmental alterations was illustrated by the fact that all fish species recorded at the beginning of 1979 were present at the end of 1982 desoite fact that all fish species recorded at the beginning of 1979 were present at the end of 1982, despite major habitat and food resource changes. (Au-thor's abatract)

DISPERSION IN ICE-COVERED LAKES, Uppsala Univ. (Sweden). Dept. of Hydrology. L. Bengtsson.

Nordic Hydrology NOHYBB, Vol. 17, No. 3, p 151-170, 1986. 9 fig, 2 tab, 19 ref.

Descriptors: *Ice cover, *Mathematical equations, *Lakes, *Iced lakes, *Water currents, *Mixing, *Dispersion, Dye releases, Seiches.

The effect of effluent releases in ice covered lakes has had to be calculated using formulae and coefficients determined for ice free conditions. A general discussion on circulation in ice covered lakes, a discussion on dispersion, and dispersion studies from three ice covered lakes are presented. One of the lakes has a large river through flow. In the other two lakes, small seiche- induced currents are generated through wind action on ice cover. Dispersion coefficients are computed from five dye experiments lasting from half a day to sixteen days. These coefficients are related to measured current experiments lasting from half a day to sixteen days. These coefficients are related to measured current velocities. The turbulence in the river-flow domi-nated lake is found to be very low with dispersion coefficients less than 1 sq cm/s in directions trans-verse to the flow. In the lakes where the turbu-lence is generated by shear from the seiche-in-duced currents the horizontal dispersion coeffi-cients are two orders of magnitude higher, being almost as high as ice free lakes. (Author's abstract) W87-04554

MIGRATION OF REACTOR-PRODUCED TRITIUM IN LAKE HURON, Helath and Welfare Canada, Ottawa (Ontario). En-ivronmental Radiation Hazards Div. For primary bibliographic entry see Field 5B. W87-04579

DISTRIBUTION AND NATURE OF ORGANIC MATTER IN RECENT SEDIMENTS OF LAKE NOKOUE, BENIN (WEST AFRICA), Perpignan Univ. (France). Lab. of Marine Sedimentalogy and Geochemistry.
For primary bibliographic entry see Field 2L. W87-04608

HEADSPACE EQUILIBRATION TECHNIQUE FOR MEASUREMENT OF DISSOLVED GASES IN SEDIMENT PORE WATER,

Maryland Univ., Solor

Lab.
N. J. Fendinger, and D. D. Adams.
International Journal of Environmental Analytical
Chemistry IJEAA9, Vol. 23, No. 4, p 253-265,
1986. 4 fig. 5 tab, 18 ref. OWRT A-059-OHIO,
EPA Contract R806757-01-1.

Descriptors: *Measuring instruments, *Water anal-ysis, *Dissolved gases, *Sediments, *Interstitial water, *Chromatography, Lake Erie, Carbon diox-ide, Methane, Detection limits, Argon, Nitrogen.

ide, Methane, Detection limits, Argon, Nitrogen.

Measurements of sediment pore water gases (N2, CH4, Ar, and CO2) have been used to assess eutrophic status of lakes, microbial activity in sediments, and in sediment oxygen demand studies. Analysis of dissolved pore water gases usually consist of two steps: (1) extraction of pore water from the sediment with a squeezer and (2) stripping of dissolved gases from the extracted pore water by an inert gas followed by gas chromatographic (GC) analysis. The analysis usually requires bulky, specialized equipment, a large sediment sample to obtain a sufficient amount of pore water for GC analysis, and is time consuming. Multiphase head-space equilibration with gas chromatographic analysis was used for the simultaneous analysis of CH4 and N2 in Lake Erie sediment pore water, with total CO2 concentrations determined on a separate duplicate sediment sample. The minimum detectable concentrations of Ar, N2, CO2, and CH4 in a Lake Erie sediment were 1.55, 0.96, 2.50, and 1.01 ml/L, respectively, using a thermal conductivity detector. Precision of the dissolved gas analysis ranged from + or - 0.24 to + or - 0.41 ml/L. (Alexander-PTT) W87-04629

RESPONSE OF THE RESPIRATORY RATE OF DAPHNIA MAGNA TO CHANGING FOOD CONDITIONS, Max-Planck-Inst. fuer Limnologie zu Ploen (Ger-

many, F.R.). W. Lampert.
Oecologia OECOBX, Vol. 70, No. 4, p 495-501, November 1986. 8 fig. 32 ref.

Descriptors: "Nutrients, "Daphnia, "Cladoce "Algae, "Respiration, "Zooplankton, "Fo chains, Assimilation, Specific dynamic acti Plankton, Starvation, Respirometers, Inver

Energy or carbon balances of aquatic invertebrates are usually based upon the equation: Production = Assimilation - Respiration. In the majority of cases two of the three parameters are measured and the third is calculated by the difference. The respiratory rate of the cladoceran Daphnia magna was measured at varying concentrations of a green alga in a flow-through respirometer. Daphnids were either preconditioned to the respective food concentration or the food concentration was suddenly changed during the experiment and the response of centration of the food concentration was studently changed during the experiment and the response of the respiratory rate monitored. Previously starved animals were provided with food or prefed animals were deprived of food. The respiratory rate in-creased considerably with increasing concentra-

Field 2-WATER CYCLE

Group 2H-Lakes

tions of algae until a maximum rate was reached at a critical algal concentration corresponding to the 'incipient limiting level' for feeding. The response of the respiratory rate to changing food conditions was fast, lagging only a few minutes behind the change in food. The respiratory rate of starved daphnids increased quickly when they received food, even at low concentrations. Prefed daphnids responded to the replacement of the food suspension by filtered water with reductions in their respiratory rates. A linear relationship between the assimilation rate and the respiration rate was found, indicating that the more than twofold range of the respiratory rate was due to specific dynamic action (SDA). The SDA coefficients of 0.15-0.24 found for Daphnia are consistent with values for marine zooplankton. (Alexander-PTT)

IS SPECIATION OF DEMERSAL FISHES IN LAKE TANGANYIKA RESTRAINED BY PHYS-ICAL LIMNOLOGICAL CONDITIONS,

ICAL LIMNOLOGICAL CONDITIONS, Rhodes Univ., Grahamstown (South Africa). Inst. of Freshwater Studies. D. H. Eccles. Biological Journal of the Linnean Society BILSBG, Vol. 29, No. 2, p 115-122, October 1986. 1 fig, 1 tab, 22 ref.

Descriptors: "Species diversity, "Speciation, "De-mersal fish, "Fish, "Limnology, "Lakes, Lake Tan-ganyika, Upwelling, Lake Malawi, Lake Victoria, Oxygen, Anoxia.

Oxygen, Anoxia.

Both Lake Malawi and Lake Victoria have many species of offshore demersal cichlids, most of which are stenotopic. In Lake Tanganyika there are fewer, more eurytopic, demersal species. These differences may be the effect of the physical regimes of the lakes. In Lake Victoria there is no permanent anoxic layer. In both the other lakes, water below 250 m depth is permanently anoxic and the seasonal cycle is dominated by upwelling. In Lake Malawi this is mainly derived from intermediate water containing free oxygen. In Lake Tanganyika upwelling involves hypolimnetic water, which may rise to within 80 m of the surface, causing great short-term changes in oxygen concentration over the depth range 50-250 m. This inhibited the development of deep water species restricted to narrow depth ranges. The lack of a wide range of stenotopic deep-water species in the lake is not a reflection of any difference in modes of speciation or of the relative ages of the lakes. (Wood-PTT)

STATUS OF THE FRESHWATER PEARL MUSSEL MARGARITIFERA MARGARITI-FERA L. IN THE SOUTH OF ITS EUROPEAN

Bayreuth Univ. (Germany, F.R.). Dept. of Animal Ecology.

ary bibliographic entry see Field 5C.

QUANTITY OF LEAD SHOT, NYLON FISH-ING LINE AND OTHER LITTER DISCARDED

ING LINE AND OTHER LITTER DISCARDED ATA COARSE FISHING LAKE, University of Wales Inst. of Science and Technolo-gy, Newbridge-on-Wye. Llysdinam Field Center. For primary bibliographic entry see Field 5B. W87-04657

GARDSJON PROJECT: LAKE ACIDIFICA-TION, CHEMISTRY IN CATCHMENT RUNOFF, LAKE LIMING AND MICROCATCH-MENT MANIPULATIONS, Swedish Environmental Research Inst., Goete-

For primary bibliographic entry see Field 5C. W87-04696

DIATOM-BASED PH RECONSTRUCTION STUDIES OF ACID LAKES IN EUROPE AND NORTH AMERICA: A SYNTHESIS, University Coll., London (England). Palaeoecology Research Unit.

For primary bibliographic entry see Field 5B. W87-04727

PIRLA PROJECT (PALEOECOLOGICAL IN-VESTIGATION OF RECENT LAKE ACIDIFI-CATION): PRELIMINARY RESULTS FOR THE ADIRONDACKS, NEW ENGLAND, N. GREAT LAKES STATES, AND N. FLORIDA, Indiana Univ. at Bloomington. Dept. of Biology. For primary bibliographic entry see Field 5B. W87-04728

COMPARISON OF PALEOLIMNOLOGICAL WITH MAGIC MODEL RECONSTRUCTIONS OF WATER ACIDIFICATION, Norsk Inst. for Vannforskning, Oslo. For primary bibliographic entry see Field 5B. W87-04729

CHANGES IN FISH POPULATIONS IN SOUTHERNMOST NORWAY DURING THE LAST DECADE, Direktoratet for Vilt og Ferskvannsfisk, Trondheim (Norway).
For primary bibliographic entry see Field 5C.
W87-04730

EVIDENCE FOR RECENT ACIDIFICATION OF LENTIC SOFT WATERS IN THE NETHER-LANDS, Katholieke Univ. Nijmegen (Netherlands). For primary bibliographic entry see Field 5B. W87-04731

POLLUTED PRECIPITATION AND THE GEOCHRONOLOGY OF MERCURY DEPOSI-TION IN LAKE SEDIMENT OF NORTHERN MINNESOTA, Group for the South Fork, Inc., Bridgehampton, NY.

For primar W87-04733 ary bibliographic entry see Field 5B.

ECOLOGICAL EFFECTS OF ACIDIFICATION ON PRIMARY PRODUCERS IN AQUATIC

Toronto Univ. (Ontario). Dept. of Botany. For primary bibliographic entry see Field 5C. W87-04734

FISH RESPONSES TO ACIDITY IN QUEBEC LAKES: A REVIEW, Quebec Ministere de l'Environnement, Sainte-Foy. For primary bibliographic entry see Field 5C. W87-04737

FISH SPECIES DISTRIBUTION IN RELATION TO WATER CHEMISTRY IN SELECTED MAINE LAKES

Maine Univ. at Orono. Dept. of Zoology. For primary bibliographic entry see Field 5C. W87-04738

FISH SPECIES DISTRIBUTION AND WATER CHEMISTRY IN NOVA SCOTIA LAKES, Nova Scotia Dept. of the Environment, Halifax. For primary bibliographic entry see Field 5C. W87-04739

AVOIDANCE OF LOW PH AND ELEVATED AL CONCENTRATIONS BY BROOK CHARR (SALVELINUS FONTINALIS) ALEVINS IN LABORATORY TESTS,

Guelph Univ. (Ontario). Dept. of Zoology. For primary bibliographic entry see Field 5C. W87-04740

BIOLOGY AND CHEMISTRY OF THREE PENNSYLVANIA LAKES: RESPONSES TO ACID PRECIPITATION, Lehigh Univ., Bethlehem, PA. Center for Marine and Environmental Studies.

P. T. Bradt, J. L. Dudley, M. B. Berg, and D. S.

Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 505-513, September 1986. 1 fig, 3 tab, 38

Descriptors: *Water pollution effects, *Acid lakes, *Phytoplankton, *Zooplankton, *Acid rain, Lakes, Acidification, Species diversity, Drainage basins, Hydrology, Alkalinity, Pennsylvania, Tolerance.

Northeastern Pennsylvania receives some of the most acidic precipitation in North America and contains surface waters sensitive to acidification. most acidic precipitation in North America and contains surface waters sensitive to acidification. Soils are generally acidic and many surface waters are low in dissolved minerals. To our knowledge previous studies in the area have recorded only one time chemical analyses with no time-trend studies of either biology or chemistry. The biology and chemistry of three northeastern Pennsylvania lakes was studied from summer 1981 through summer 1983. At the acidified lake (total alkalinity or <= 0.0 micro eq/L) there were fewer phytoplankton and zooplankton species than at the moderately sensitive lakes. The most numerous plankton species in all three lakes are reportedly acid tolerant. Among the benthic macro-invertebrates (BMI) there were more acid tolerant Chironomidae at the acidified lake, but more acid intolerant Ephemeroptera and Mollusca and a higher wet weight at the least sensitive lake. There were no differences among the lakes' BMI mean total numbers or mean number of taxa. The fish community at the acidified lake was dominated by stunted Lepomis gibbosus, but L. machrochirous were most abundant in the other lakes. Principal component analysis suggested a shift in all three lakes over the sampling period toward combined lower PI, alkalinity, specific conductance, Ca and Mg and higher Al and Mn. Such chemical changes have been associated with acidification. The rate and extent of acidification appeared to be controlled by geological and hydrological characteristics of the drainage basins. (Alexander-PTT) W87-04741 W87-04741

BONE CONCENTRATION OF MANGANESE IN WHITE SUCKER (CATOSTOMUS COM-MERSOND FROM ACID, CIRCUMNEUTRAL AND METAL-STRESSED LAKES, Toronto Univ. (Ontario). Dept. of Zoology. For primary bibliographic entry see Field 5C.

W87-04742

LABORATORY EVALUATION OF GAMBUSIA AFFINIS FISH AS PREDATORS OF THE SCHISTOSOME-BEARING SNAILS BULINUS TRUNCATUS.

American Univ., Beirut (Lebanon). Dept. of Envi-ronmental Health.

A. Acra, R. Milki, Z. Raffoul, Y. Karahagopian, and M. Fletcher.

Journal of Tropical Medicine and Hygiene, Vol. 89, No. 1, p 7-12, February 1986. 4 tab, 12 ref.

Descriptors: *Gambusia, *Fish, *Predation, *Snails, *Schistosomes, *Food habits, *Food chains, *Biocontrol, *Biocontrol, *Human diseases, Mollusks, Diseases, Public health, Epidemiology, Bulinus, Physa, Ponds, Reservoirs.

A laboratory-based study involving numerous experiments demonstrated that the mosquito fish Gambusia affinis preys effectively upon the schistosome bearing snail Bulimus truncatus, even in the presence of an alternative source of food. Egg masses and juvenile snails up to 2 mm in size are preferred. Individual egga are nibbled, and the tiny snails with fragile shells are swallowed and digestical. In the absence of other foods, the fish consume the flesh of snails 3 to 6 mm in size, leaving their empty shells intact. The larger snails are unharmed, but their offspring could be eradicated by the fish under favorable conditions. It is concluded that Gambusia can provide a substantial degree of biocontrol in small bodies of somewhat stagnant water such as ponds, pools, reservoirs, and cisterns. (Author's abstract)

SPAWNING MIGRATION OF GREAT LAKES PINK SALMON (ONCORHYNCHUS GORBUS-CHA): SIZE AND SEX DISTRIBUTIONS, RIVER ENTRANCE AND EXIT,

Department of Fisheries and Oceans, Sault Ste. Marie (Ontario). Great Lakes Fisheries Research

W. Kwain, and G. A. Rose. Journal of Great Lakes Research JGLRDE, Vol. 12, No. 2, p 101-108, 1986. 4 fig, 2 tab, 23 ref.

Descriptors: *Fish migration, *Population dynamics, *Salmon, *Fish populations. Lake fisheries.

ics, "Salmon, "Fish populations, Lake fisheries. Pink salmon migrated in an easterly direction into the Carp and Pancake Rivers, Lake Superior, from 26 August to 30 September 1981. Population estimates were 7500 (Carp R.) and 7285 (Pancake R.) fishes. Peaks in numbers of fish entering the rivers followed onshore wind events. River entrance peaked between 2000 and 2400 h. Fish moved within the rivers at approximately 1 km/d. The proportions of females, 35% at Carp and 45% at Pancake, were low compared to those of Pacific Stocks, and varied temporally, being lowest early in the migrations. Mean size of male migratis varied over time, with smaller males coming first, followed by larger males. Toward the end of the migrations, mean length of males decreased. Mean length of females did not vary temporally. At each river, several hundred fish that had not spawned were recaptured attempting to return to the lake. Many were recaught several times, each time being replaced upstream; 32 such fish were subsequently recaught in nearshore nets. This exiting of rivers was greater than previously reported for Pacific stocks. We hypothesize that in Great Lakes pink salmon, exiting rivers is a characteristic of straying behavior, and that straying has been selected for in success. We hypometage that in Ureat Lakes pink salmon, exiting rivers is a characteristic of straying behavior, and that straying has been selected for in this stock. (McFarlane-PTT) W87-04744

CURRENT PERSPECTIVES ON THE LAKE ERIE WATER BALANCE,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.

Journal of Great Lakes Research JGLRDE, Vol 12, No. 2, p 109-116, 1986. 7 fig, 3 tab, 14 ref.

Descriptors: *Lake Erie, *Hydrologic budget, *Hydrologic data, Water level fluctuations, Evaporation rate, Water use, Basins, Rainfall, Runoff, River flow, Seasonal variation, Water storage.

An analysis was conducted of the Lake Erie water balance for 1940-79, based on the individual hydrologic components, including thermal expansion and consumptive use. Particular emphasis was given to the continuity of the system. Annual and monthly statistics are presented fo each of the water balance components. While the Detroit River contributed 37% of the Lake Erie total water supply, the variability of the net basin supplies was also found to be of importance in explaining annual water level fluctuations. A major step function was found to occur in the annual water balance between 1958 and 1959, which illustrates the large discontinuities that can occur when calculating the net basin supplies from residuals rather than directly from recipitation, runoff, and evaporation. The annual suppues from readulars faunter than directly from precipitation, runoff, and evaporation. The annual water balance for 1959-79 was found to be well astisfied with an average annual residual of about 0.5 percent of the Detroit River or Niagara River 0.5 percent of the Detroit River or Niagara River flow. A distinct seasonality was noted in the mass continuity of the monthly water balance. Also on a seasonal basis, the change in storage due to thermal expansion was significant during the late spring and early fall months. (McFarlane-PTT) W87-04745

POPULATION CHARACTERISTICS OF THE INVADING WHITE PERCH (MORONE AMER-ICANA) IN WESTERN LAKE ERIE, Ohio Cooperative Fishery Research Unit, Colum-

J. S. Schaeffer, and F. J. Margraf. Journal of Great Lakes Research JGLRDE, Vol. 12, No. 2, p 127-131, 1986. 3 fig, 2 tab, 13 ref.

Descriptors: *Species diversity, *Population dynamics, *Fish populations, Fish migration, Growth, Spawning, Recruitment, Lake Erie, Great Lakes, Fish.

Lakes, Fish.

The white perch is an East Coast estuarine species that invaded Lake Erie in the 1950s, but did not increase in abundance until the mid 1970s. Its distribution and population dynamics in western Lake Erie during this period of rapid increase in population size were examined. White perch spawned in rifle areas of tributary streams of western Lake Erie during late April, and then moved downstrean into the lake. They were abundant in nearthean and reef habitats throughout most of the year, although a few were collected in deep off-shore areas. Increasingly strong year classes were produced each year in 1980-84. The age structure of the population reflected a surge in recruitment in the 1980s; fish of age-1 and age-2 were abundant, but older fish were still rare. White perch in western Lake Erie grew faster and matured earlier than those in most other populations, but growth rates appeared to be declining as the population expanded. White perch can be expected eventually to colonize suitable habitats throughout the Great Lakes. (McFarlane-PTT) Lakes. (McFarlane-PTT)

ALGAL ORGANIC CARBON EXCRETION IN LAKE MICHIGAN,

National Oceanic and Atmospheric Administra-tion, Ann Arbor, MI. Great Lakes Environmental Research Lab.

G. A. Laird, D. Scavia, and G. L. Fahnenstiel. Journal of Great Lakes Research JGLRDE, Vol. 12, No. 2, p 136-141, 1986. 3 fig, 1 tab, 39 ref.

Descriptors: *Nutrients, *Cycling nutrients, *Organic carbon, *Lake Michigan, *Excretion, *Phytoplankton, *Algae, Carbon cycle, Carbon-14, Metabolism, Incubation, Isotope studies, Bioaccumusers

Algal external metabolites have been claimed to be an important carbon source for aquatic heterotrophic bacteria. The release by algae of recentlyized carbon was measured by following the accumulation of carbon 14 organics in filtrates of Lake Michigan samples incubated under natural light for 8 to 26 h. Pretreatment of samples with an antibiotic and a suite of nonradioactive amino acids, to prevent microbial uptake of excreted products, did not affect the apparent release rates which ranged between 2 and 21% of short-term autotrophic production. Comparison of the release rates of 0.42 to 1.54 mg C per cu m per day to estimates of duction. Comparison of the release rates of 0.42 to 1.54 mg C per cu m per day to estimates of bacterial demand made during a simultaneous study suggests that organic carbon released from recently-fixed internal pools may not alone support bacterial production. (Author's abstract) W87-04749

BYTHOTREPHES CEDERSTROEMI (SCHOEDLER). (CERCOPAGIDAE: CLADO-CERA): A NEW RECORD FOR LAKE ONTAR-

10, Beak Consultants, Inc., Akron, NY. C. Lange, and R. Cap. Journal of Great Lakes Research JGLRDE, Vol. 12, No. 2, p 142-143, 1986. 2 fig. 5 ref.

Descriptors: *Cladocera, *Bythotrephes, *Lakes Ontario, *Populations, *Species composition, Zoo-plankton, Taxonomy.

Specimens of the cladoceran, Bythotrephes ceder-stroemi (Schodler), were identified from samples obtained from the New York State Electric and Gas Corporation's Somerset Coal Generating Sta-tion near Lake Ontario at Somerset. This organism, not previously reported in Lake Ontario, was present in samples from September through De-cember 1985. (McFarlane-PTT) W87-04750

FIRST RECORDS OF A EUROPEAN CLADO-CERAN, BYTHOTREPHES CEDERSTROEMI, IN LAKES ERIE AND HURON, Fish and Wildlife Service, Sandusky, OH. Biologi-

cal Station. M. T. Bur, D. M. Klarer, and K. A. Krieger. Journal of Great Lakes Research JGLRDE, Vol. 12, No. 2, p 144-146, 1 tab, 13 ref.

Descriptors: *Cladocera, *Bythotrephes, *Lake Erie, *Lake Huron, *Species composition, Zoo-plankton, Taxonomy, Predation, Food chains, Great Lakes.

Adult forms of the cladoceran Bythotrephes ceder-stroemi Schoedler (Cercopagidae), a widespread Eupopean freshwater zooplankter, occurred in the stomachs of four common species of Lake Erie fish (yellow perch, white perch, white bass, and wal-leye) collected in early October 1985. The fish were collected in early October 1985. The fish were collected at several stations in the nearshore open waters of the central basin between Ashtabu-la and Huron, Ohio. Other investigators have seen this species in other locations in Lake Erie and also in Lake Huron. The report of B. cederstroemi in Lake Huron. The report of B. cederstroemi in Lake Huron. The report of B. cederstroemi in Lake Huron in December 1984 appears to be the first record of this species in North America.

(McFarlane-PTT) (McFarlane-PTT) W87-04751

DISSOLVED-OXYGEN DEPRESSION UNDER ICE COVER IN TWO YUKON RIVERS, Inland Waters Directorate, Vancouver (British Co-lumbia). Pacific and Yukon Region. For primary bibliographic entry see Field 2C. W87-04757

HYDRAULICS OF FLOODPLAIN FLOWS, For primary bibliographic entry see Field 2E. W87-04768

PLANT VIRUSES IN RIVERS AND LAKES, Biologische Bundeanstalt füer Land-Forstwirtschaft, Brunswick (Germany, F.R.). Inst. füer Viruskrankheiten der Pflanzen. For primary bibliographic entry see Field 5A. W87-04821

RESTORATION OF TWO LOWLAND LAKES BY ISOLATION FROM NUTRIENT-RICH WATER SOURCES WITH AND WITHOUT RE-MOVAL OF SEDIMENT,
University of East Anglia, Norwich (England).
School of Environmental Sciences.
For primary bibliographic entry see Field 5G.
W87-04832

BATTLING A RISING GREAT SALT LAKE, For primary bibliographic entry see Field 4A. W87-04837

EFFECT OF WATER BALANCE ON GROWTH AND CALCIUM MOBILIZATION OF EMBRY-ONIC PAINTED TURTLES (CHRYSEMYS

PICTA),
Colorado State Univ., Fort Collins. Dept. of Zool-

ogy and Entomology.
M. J. Packard, and G. C. Packard.
Physiological Zoology PHZOA9, Vol. 59, No. 4, p
398-405, July-August 1986. 7 fig, 4 tab, 21 ref. NSF
Grant DCB 83-8555.

Descriptors: *Water pollution effects, *Water exchange, *Metabolism, *Hydrologic budget, *Calcium, *Turtles, Embryonic growth stage, Eggs.

Flexible-shelled eggs of painted turtles were incubated in wet and dry substrates to elicit different patterns of net water exchange between eggs and their environment. Embryos exposed to wet substrates consumed yolk more rapidly, grew faster and incubated longer than did embryos exposed to dry substrates. Hatchlings emerging in wet environments were larger and contained less residual yolk than hatchlings emerging in dry environments. Embryos exposed to wet and dry conditions relied on both yolk and eggshell to supply the calcium required for development. However, embryos exposed to wet substrates used the eggshell for a larger proportion of their calcium (36%) than did embryos exposed to dry substrates (40%). Re-

Field 2-WATER CYCLE

Group 2H-Lakes

sidual yolk of hatchlings in both groups contained less than one milligram of calcium. Consequently, residual yolk cannot support growth of neonates at or near levels characteristic of late-term embryos. Thus, the larger energy reserve avalable to small hatchlings in the form of a large residual yolk probably can be used only to support maintenance metabolism, and the young must begin to forage acon after emerging from the nest if growth of both hard and soft tissues is to continue. (Author's abstract')

IMPLICATIONS OF MARSH SIZE AND ISO-LATION FOR MARSH BIRD MANAGEMENT, Iowa State Univ., Ames. Dept. of Animal Ecolo

gy. For primary bibliographic entry see Field 6G. W87-04872

INTERACTION OF CERTAIN HEAVY
METALS WITH LAKE HUMIC ACIDS,
Kashmir Univ., Srinagar (India). Centre of Research for Development.
For primary bibliographic entry see Field 5B.
W87-04884

DIATOM-INFERRED PH CALIBRATION OF LAKES NEAR WAWA, ONTARIO, Trent Univ., Peterborough (Ontario). Environmental Centre. For primary bibliographic entry see Field 5A. W87-04938

DIRECT DISTRIBUTION MODEL FOR RE-GIONAL AQUATIC ACIDIFICATION, Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering. For primary bibliographic entry see Field 5B. W87-04941

MODEL FOR WETLAND SURFACE WATER DYNAMICS, Michigan Science and Engineering Associates, Ann Arbor. For primary bibliographic entry see Field 2E. W87-04957

NATURAL AND ANTHROPOGENIC CAUSES OF LAKE ACIDIFICATION IN NOVA SCOTIA, Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology. For primary bibliographic entry see Field 5B. W87-04985

ECOLOGICAL GENETICS OF THE CYCLIC PARTHENOGENS, DAPHNIA LONGISPINA AND DAPHNIA PULEX, Helsinki Univ. (Finland). Dept. of Genetics.

H. Korpelainen. Hereditas HEREAY, Vol. 105, No. 1, p 7-16, October 1986. 1 fig, 9 tab, 22 ref.

Descriptors: *Genetic diversity, *Genetic studies, *Parthenogens, *Cladophora, *Ponds, *Seasonal variation, Ecology, Genetic structure, Population dynamics, Populations, Finland, Competition.

A population of Daphnia longispina which inhabited a rock pool in southern Finland was found to possess a relatively stable genetic structure, while a population of D. pulex appeared genetically unstable. Unlike the population of D. magna inhabiting singe species pools in the same area and which maintained approximately the same level of genetic variation throughout seasons, the D. pulex population was characterized by decreasing genetic dimaintained approximately the same level of genetic variation throughout sessons, the D. pulex population was characterized by decreasing genetic diversity toward autumn and across years. A clue to the surprisingly different behavior of the D. pulex population could be different biotic selective pressures. The population of D. longispina and D. pulex studied here had to compete with another closely related species, D. magna. D. longispina appeared to outcompete D. magna completely, while D. pulex was exposed to more continuous competition. Selection favoring a few well compet-

ing clones is a likely explanation for the extensive decrease in genetic diversity observed in the popu-lation of D. Pulex. (See also W87-04991) (Author's

COMPETITION BETWEEN CLONES: AN EX-PERIMENTAL STUDY IN A NATURAL POPU-LATION OF DAPHNIA MAGNA, Helsinki Univ. (Finland). Dept. of Genetics.

H. Korpelainen. Hereditas HEREAY, Vol. 105, No. 1, p 29-35, October 1986. 1 fig, 3 tab, 15 ref.

Descriptors: *Genetic diversity, *Competition, *Clones, *Genetic studies, *Population dynamics, *Ponds, Competing use, Habitats, Aquatic habitats, Species diversity, Finland, Populations.

A competition experiment was carried out in a natural population of Daphnia magna inhabiting a small rock pool in southern Finland by introducing individuals from a laboratory grown clone into the population. The experiment tested the hypothesis that the high degree of genetic divergence observed in Daphnia populations would at least partly be maintained by competitive interactions which prevent a new clone from becoming an established member of the population. The introduced clone proved to be inferior in the competition, and in only a few weeks the original clones outcompeted the new clone to a low frequency. Accordingly, the genetic composition of the population recovered from the artificial disturbance. D. magna populations seem to inhabit contrasting nation recovered from the artificial disturbance. D. magna populations seem to inhabit contrasting habitats with unique selection pressures, which leads to population differentiation. In general, habitat discontinuity and restricted gene flow together with interference competition among conspecific genotypes confer an excellent opportunity for genetic divergence among populations. (See also W87-04990) (Author's abstract)

ECOLOGY OF SCENEDESMUS BLOOMS, Osmania Univ., Hyderabad (India). Dept. of Osmania City, nyueraosa (intas). Dept. of Botany. G. B. Reddy, V. Venkateswarlu, and A. N. Rao. Indian Journal of Botany IJBODX, Vol. 8, No. 2, p 145-147, December 1985. 1 tab, 5 ref.

Descriptors: *Bioaccumulation, *Scenedesmus, *Nutrients, *Eutrophication, *Algae, Ecology, Physicochemical properties, Proteins, Carbohydrates, Cisterns, India.

nus armatus var. major G. M. Smith an Scenedesmus armatus var. major G. M. Smith and Scenedesmus dimorphus (Turp). Kuetz growing in a rocky cistern and in rocky pans located on the Osmania University campus were studied. The blooming algae were abundant in these environ-ments so the physicochemical parameters including temperature. M and the assenter of practice or other. ments so the physicochemical parameters including temperature, pH, and the amount of protein, carbo-hydrate, organic matter and inorganics were deter-mined. The Scenedesmus species under investiga-tion appeared to have efficient nutrient uptake and developed blooms in the presence of rich nutrients. developed blo

ECOLOGICAL STUDIES IN SOME PONDS OF OSMANIA UNIVERSITY CAMPUS WITH SPE-CIAL REFERENCE TO BOTTOM LIVING ALGAE: I. PHYSICO-CHEMICAL FACTORS, Osmania Univ., Hyderabad (India). Dept. of Botany

A. N. Rao. Indian Journal of Botany IJBODX, Vol. 8, No. 2, p 148-152, December 1985. 3 tab, 22 ref.

Descriptors: "Nutrients, "Ecology, "Algae, "Ponds, "Physicochemical properties, India, Chlorides, Phosphates, Ammonia, Nitrates, Silicates, Dissolved oxygen, Oxygen, Iron, Hydrogen ion concentration, Water analysis, Osmania University."

The physicochemical characteristics of three fresh water ponds on the Osmania University campus were studied over a period of two years. Chlor-

ides, phosphates and ammonia were found in low concentrations. Nitrates and silicates were record-ed in high proportions. Dissolved oxygen was ob-served in moderate quantities but the iron content was low. Vegetation types were listed and included the angiospermic species Ottelia alismoides, Limnophila heterophylla, and Ipomoea aquatica. (Wood-PTT) W87-05000

MODELLING THE FATE OF MIREX AND LINDANE IN LAKE ONTARIO, OFF THE NI-AGARA RIVER MOUTH, National Water Research Inst., Burlington (Ontar-io). Environmental Simulation Section. For primary bibliographic entry see Field 5B. W87-05002

ECOSYSTEM'S MEMORY IN THE CONTEXT OF STRUCTURAL DYNAMICS, Kinneret Limnological Lab., Tiberias (Israel). H. Volohonsky. Ecological Modelling ECMODT, Vol. 33, No. 1, p 59-75, September 1986. 7 ref.

Descriptors: *Ecosystems, *Structural dynamics, *Mathematical equations, *Mathematical analysis, *Mathematical studies, *Energy, Energy dissipation, Populations, Chemical composition.

non, Populations, Chemical composition.

A quaternion describing dissipative system states and interactions in terms of extensive (energetic) and intensive (structural) characteristics was formalized. Absorption, emission and dissipation of energy are presented in terms of rotations towards certain axes of quaternion space. Structural parameters may be associated with 'memory' of ecosystem channels (populations) and of the overall system. A simple analysis demonstrates that self reproduction of populations and ecosystem's steady state (or 'self reproduction of the ecosystem') are incompatible in conditions of constant chemical composition, meaning that no ecosystem can persist forever. However, ecosystems find ways to persist for periods longer than time scales of individual development of their leading species through the set of strategies generally resulting in increased structural characteristics. (Author's abstract) W87-05004

UPTAKE OF AMINO ACIDS BY CULTURED AND FRESHLY ISOLATED SYMBIOTIC CHLORELLA,

Oxford Univ. (England). Dept. of Plant Sciences. P. J. McAuley. New Phytologist NEPHAV, Vol. 104, No. 3, p 415-427, November 1986. 6 fig, 6 tab, 36 ref.

Descriptors: *Bioaccumulation, *Cultures, *Nutrients, Proline, Serine, Alanine, Glycine, Glutamine, Arginine, Lysine, Hydrogen ion concentration, Growth, Cells, Metabolism, Accumulation.

Amino acid uptake was investigated in two cultured strains of symbiotic Chlorella sp., 3N813A and NC64A, and in Chlorella algae freshly isolated from symbiosis with the European strain of Hydra viridissima; E/E algae (the natural symbiont) and E/3N and E/NC algae (3N813A and NC64A in artificial symbiosis). Cultured 3N813A possessed at least two active uptake systems, a general system artinical symbols. Culture 1306139 possesses a least two active uptake systems, a general system transporting proline, serine, alanine, glycine and glutamine, and one transporting arginine and lysine (although uptake of the latter was low). Unusually, (although uptake of the latter was low). Unusually, arginine appeared to be transported in its neutral form, since low pH inhibited uptake. Cultured NC64A possessed only the arginine/lysine system, but in E/NC isolated from symbiosis the general system was also present. Algae freshly isolated from symbiosis showed a more active, rapidly saturated general transport system than cultured 3N813A, in which uptake was linear over a 2 h time course. Uptake of arginine was not affected by growth in symbiosis, but both E/3N and E/NC algae took up lysine at a faster rate than cultured 3N813A and NC64A. Attempts to introduce higher activity of the two transport systems in cultured algae were mostly unsuccessful. Growth in nitrogen-deficient medium reduced rather than

Lakes-Group 2H

increased uptake of proline and alanine by 3N813A, and it had no effect on lysine uptake; and although this treatment increased uptake of lysine by NC64A, neither nitrogen deficiency nor pre-treatment with glucose induced the general transport system. The implications of the ability of algae symbiotic with hydra to take up amino acids are discussed with special reference to host cell regulation of algal cell division. (Author's abstract) W87-05005

TROPHIC STRUCTURE IN SOUTHERN ON-TARIO STREAMS, Guelph Univ. (Ontario). Dept. of Zoology. J. N. Bowlby, and J. C. Roff. Ecology ECOLAR, Vol. 67, No. 6, p 1670-1679, December 1986. 3 fig, 6 tab, 51 ref.

Descriptors: *Population dynamics, *Streams, *Trophic level, *Biomass, *Fish, *Invertebrates, *Microorganisms, *Pood chains, Ontario, Habitats, Riffles, Shallow water, Predation, Limiting nutri-

rements, snamow water, Predation, Limiting nutrients, Prediction.

The biomass and abundance of organisms at the nonpiscivorous fish, benthic invertebrate predator and nonpredator, and microcommunity trophic levels at 30 stream sites in southern Ontario were examined to test the food limitation, predation, and habitat limitation hypotheses of regulation of trophic structure. The presence of piscivorous fish at seven sites allowed a direct contrast between the predictions of the 'bottom-up' (food limitation) and 'top-down' (predator limitation) hypotheses. Also, the size-efficiency hypothesis (size-selective predation) at the nonpiscivorous fish and benthic invertebrate trophic levels was tested. In the presence of piscivores, the biomass of nonpiscivorous fish was lower and the biomass and abundance of benthic invertebrates were higher than in the absence of piscivores. Microcommunity biomass did not differ at sites with versus sights without piscivores. Thus, the bottom-up hypothesis was rejected in favor of the top-down hypothesis. The indirects of the top trophic level on lower levels decreased with 'distance' from the top of the food chain. Also, benthic invertebrate predators were larger in the presence of piscivores, consistent with the size-efficiency hypothesis. The habitat limitation hypothesis was also supported at the benthic invertebrate and non-piscivorous fish trophic levels. Invertebrate biomass and abundance were positively related to extent of riffles. This complementary distribution may be determined by fish predation on the invertebrates. (Author's abstract)

EFFECTS OF SMALL IMPOUNDMENTS ON HYDROPSYCHID CADDISFLY PRODUCTION HYDROFSYCHID CADDISFLY PRODUCTION IN VALLEY CREEK, MINNESOTA, Toronto Univ. (Ontario). Dept. of Zoology. R. J. Mackay, and T. F. Waters. Ecology ECOLAR, Vol. 67, No. 6, p 1680-1686, December 1986. 1 fig. 5 tab, 33 ref.

Descriptors: *Productivity, *Caddisflies, *Species composition, *Insects, *Reservoirs, *Streams, Rifles, Shallow water, Valley Creek, Minnesota, Larvae, Populations, Seston, Mosses, Algae, Sand.

Annual production by filter-feeding caddisfly larvae (Trichoptera: Hydropsychidae) was estimated by the size-frequency method and compared in riffles immediately above and below small (<1 ha) impoundments or ponds at three sites in Valley Croek, Minnesota in 1982-1983. At all three sites, Creek, Minnesota in 1982-1983. At all three sites, production was significantly higher below impoundments than above. At the most upstream site, annual production by Hydropsyche slossonae was 0.9 g/sq m (dry mass) in the upper riffle but was 40.0 g/sq m in the riffle located below inputs by ponds beside the main stream. At the middle site, production by H. slossonae and a small population of Cheumatopsyche petitii was 16.2 g/sq m in the upper riffle, but was 31.7 g/sq m below two main-stream impoundments and a side pond. At the lowermost site, production by co-dominants H. slossonae and C. petitii together with Hydropsyche riola totalled 5.8 g/sq m in the upper riffle

but 34.9 g/sq m below a mainstream impoundment. Although the number of hydropsychid species increased at successive downstream sites, the proportionate representation of species in the upper riffle at a given site was almost identical to that in the lower riffle. The higher production in lower riffles was attributed to factors in pond or impoundment outflows that provided favorable conditions for species already established in the reach of creek containing the impoundment. The most likely factor was postulated to be an increase in abundance or quality of seston. Other factors were better growths of moss and filamentous algae, which provided attachment sites for retreat construction, and the absence of abrasive sand after deposition in impoundments. (Author's abstract) W87-05011

BOGS AS BEAVER HABITAT IN NORTH-CENTRAL MINNESOTA, Louisiana State Univ., Baton Rouge. Dept. of Forestry and Wildlife Management.
A. J. Rebertus.
The American Midland Naturalist AMNAAF, Vol. 116, No. 2, p 240-245, October 1986. 1 fig. 2 tab. 14 ref.

Descriptors: *Wildlife habitats, *Bogs, *Beaver habitats, *Lakes, *Rivers, *Dams, Minnesota, Flow, Seepage, Moats, Reservoirs, Habitats, Bea-

Although beavers frequently colonize lakes and streams that are adjacent to bog areas, few (Castor canadensis Huhl). Irescarchers have mentioned that beavers are capable of colonizing bogs that lack open water. In a 100-sq km area surveyed for beaver activity, one-third of the active colonies beaver activity, one-third of the active colonies were in bogs and two-thirds were in lakes and rivers. From 1979 to 1981, the percent of colonies in bogs increased from 29% to 36%. Of 481 bogs in the study area, 200 (42%) had current or previous history of beaver activity (colony sites and work areas). At 101 bogs (21%), dam construction in seepage zones created flowages. Most impoundments were built at brushy minerotrophic sites. Moats were used at 99 bogs (21%), where beavers preferred sedge-moss cover and avoided tall shrub and wooded cover. The results show that bogs are suitable habitat for beavers. (Alexander-PTT)

VEGETATION PATTERNS IN AND AMONG PANNES (CALCAREOUS INTRADUNAL PONDS) AT THE INDIANA DUNES NATIONAL LAKESHORE, INDIANA, Indiana Dunes National Lakeshore, Porter, IN. R. D. Hiebert, D. A. Wilcox, and N. B. Pavlovic. The American Midland Naturalist AMNAAF, Vol. 116, No. 2, p 276-281, October 1986. 2 fig, 2 tab, 17 ref.

Descriptors: *Vegetation patterns, *Pannes, *Cal-careous ponds, *Intradunal ponds, *Species com-position, *Species diversity, *Aquatic plants, Water chemistry, Lake Michigan, Ponds, Mathe-matical models, Hydrology, Dunes, Model studies.

There is a series of intradunal ponds (pannes) just inland from the beach dunes at the Indiana Dunes National Lakeshore. These pannes differ in origin, age and plant species composition from numerous interdunal ponds found farther inland in older dune systems. The pannes now provide habitat for plant species found nowhere else in Indiana. The relationships between plant species composition and dispersion, water chemistry and water depth/depth to water table were studied in five calcareous intradunal ponds bordering the southern tip of to water table were studied in five calcareous intradunal ponds bordering the southern tip of Lake Michigan. The panne systems contained eight plant species threatened and endangered in Indiana. The aquatic zone was dominated by Chara, the pond edge by Rhynchospora capillacea, Juncus balticus and Utricularia cormuta, and the area surrounding the pond by Hypericum kalmianum. The water chemistry was typical of hardwater ponds in the area, probably affecting species composition but not species dispersion within the pannes. A significant correlation between the first axis scores from a reciprocal-averaging ordination and water depth/depth to water was demonstrated. Panne

species are fitted to a model based on hydrology proposed by van der Laan for dune-slack vegeta-tion in the Netherlands. (Alexander-PTT) W87-05030

PAUL AND PETER LAKES: A LIMING EX-PERIMENT REVISITED, Notre Dame Univ., IN. Dept. of Biology. For primary bibliographic entry see Field 5G.

EFFECT OF MISSISSIPPI RIVER DELTA LOBE DEVELOPMENT ON THE HABITAT COMPOSITION AND DIVERSITY OF LOUISI-ANA COASTAL WETLANDS, Louis iana State Univ., Baton Rouge. Coastal Ecol-

For primary bibliographic entry see Field 2J. W87-05032

HISTORICAL AND ECOLOGICAL SOURCES OF VARIATION AMONG LAKE POPULA-TIONS OF THREESPINE STICKLEBACKS, GASTEROSTEUS ACULEATUS, NEAR COOK

GASTEROSTEUS ACULEATUS, NEAR COOK INLET, ALASKA, State Univ. of New York at Stony Brook. Dept. of Ecology and Evolution. R. C. Francis, J. V. Baumgartner, A. C. Havens, and M. A. Bell.

and M. A. Bett. Canadian Journal of Zoology CJZOAG, Vol. 64, No. 10, p 2257-2265, October 1986. 3 fig. 7 tab, 60 ref. NSF Grant BSR81-11013.

Descriptors: *Fish populations, *Sticklebacks, *Fish morphology, *Lakes, *Cook Inlet, Multivariate analysis, *Alaska, History, Ecology, Evolution, Genetics, Adaptation, Phylogeny.

tion, Genetics, Adaptation, Phylogeny.

Multivariate analyses of morphological variation of Gasterosteus aculeatus from 24 lakes in a recently deglaciated region north of Cook Inlet, Alaska, were performed. Presence or absence of the pelvis most effectively discriminates among populations. Intralocality character correlations generally were similar to interlocality correlations, but the among-locality relationship of body depth with other morphometric variables was different from its relationships within localities, which suggests that genetic reorganization during the evolution of these populations has broken the expected correlated response of body depth with other variables. Variation within different suites of covarying morphological characters is best explained by either historical processes (phylogeny, gene flow) or the present distribution of environmental variables (adaptation). The set of populations studied must have been derived from marine Gasterosteus within the past 13000 years and have diverged markedly within a relatively short period of time. Rapid and extensive diversification appears to characterize Gasterosteus from recently deglaciated regions. (Author's abstract)

LIFE HISTORIES OF LIMINEPHILUS EXTERNUS HAGEN, ANABOLIA BIMACULATA (WALKER), AND NEMOTAULIUS HOSTILIS (HAGEN) (TRICHOPTERA, LIMINEPHILIDAE) IN A POND IN SOUTHERN ALBERTA, CANADA, Calgary Univ. (Alberta). Dept. of Biology.

S. B. Berte, and G. Pritchard.
Canadian Journal of Zoology CJZOAG, Vol. 64, No. 10, p 2348-2356, October 1986. 8 fig. 3 tab, 43 ref.

Descriptors: *Life history studies, *Caddisflies, *Ponds, *Aquatic insects, Eggs, Larvae, Hatching, Reproduction, Metabolism, Water temperature, Temperature effects, Seasonal variation, Diets, Water level, Growth rates, Growth.

Limnephilus externus and Anabolia bimaculata are caddisflies that typically inhabit temporary pools, while Nemotaulius hostilis is a species that inhabits permanent pools. In a permanent pond with a fluctuating water level, both groups could be accommodated. The temporary-pool species laid egg masses on the ground above the water level in late

Field 2-WATER CYCLE

Group 2H—Lakes

summer. Larvae hatched in the autumn but re-mained in the masses until submersed by the rising water in the spring. Larvae grew at rates faster manned in the masses until summerised by the rising water in the spring. Larvae grew at rates faster than those for any permanent-water trichopteran studied to date. Limmephilus externus adults emerged through August and underwent a 1-month reproductive delay. By contrast, N. hostilis oviposited on riparian vegetation and larvae entered the water on hatching in August Larval growth rates approximated those of other detritivorous ahredders found in permanent waters. Over 75% of adult emergence occurred in I week at the end of May and adults underwent a reproductive diapause of slightly over a month's duration. The metabolic cost of high water temperatures on cool-adapted limsephilid caddisflies is postulated as the driving force behind the evolution of reproductive diapause in this family. (Author's abstract)

CONDUCTIVITY-TEMPERATURE STAND-ARDIZATION AND DISSOLVED SOLIDS ES-TIMATION IN A MEROMICTIC SALINE

LAKE, British Columbia Univ., Vancouver. Westwater Research Centre.
For primary bibliographic entry see Field 5A.
W87-05051

ALGAL PICOPLANETON FROM MARINE AND FRESHWATER ECOSYSTEMS: A MULTI-DISCIPLINARY PERSPECTIVE, Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab. J. G. Stockner, and N. J. Antia. Canadian Journal of Fisheries and Aquatic Sciences CIFSDX, Vol. 43, No. 12, p 2472-2503, December 1986. 6 fig. 6 tab, 322 ref.

Descriptors: *Primary productivity, *Limnology, *Estuarine environment, *Algae, *Picoplankton, *Reviews, *Food chains, Taxonomy, Distribution, Energy, Nutrients, Lakes, Biochemistry, Physiology, Euphotic zone.

The discovery of minute (0.2-2.0 micron) algal picoplankton in the late 1970's in both marine and freahwater ecosystems has led to a resurgence of research activity throughout the world, addressing questions related to taxonomy, distribution and abundance, physiology and biochemistry, and ecological considerations of their role in aquatic food webs. To many, their discovery provided the 'missing link' in the controversial carbon supply-demand question in the world's occans and gave further credibility to the emerging new paradigm on the importance of microbial food webs in energy transfer and nutrient recycling in aquatic systems. The first comprehensive multidisciplinary review of phototrophic picoplankton in lake and oceans ecosystems is provided. It shows that while algal picoplankton are much less abundant than free-living bacteria in the euphotec zone of lakes and oceans, they make a higher contribution to the picoplankton biomass because of their larger size. They contribute significantly to the daily and annual carbon production of lakes and oceans. Microflagellates are probably the most important grazers of algal picoplankton in aquatic ecosystems. However, the picoplankton are also grazed by ciliates and metazoans, particularly in estuaries and fjords. (Author's abstract)

DIEL VERTICAL MIGRATIONS AND HORIZONTAL DISTRIBUTIONS OF LIMNOCALANUS MACRURUS AND SENECELLA CALANOIDES (COPEPODA, CALANOIDA) IN LAKES OF SOUTHERN ONTARIO IN RELATION TO PLANKTIVOROUS FISH,

Materico Univ. (Ontario). Dept. of Biology.
J. C. H. Carter, and K. A. Goudie.
Canadian Journal of Fisheries and Aquatic Sciences CIFSDX, Vol. 43, No. 12, p 2508-2514,
December 1986. 4 fig. 3 tab, 33 ref.

Descriptors: *Copepoda, *Limnology, *Crusta-ceans, *Diurnal variation, *Nocturnal variation,

*Glacial lakes, Prediction, *Migration, *Species composition, Fish, Lakes, Spatial distributions, Transparency, Ontario.

Transparency, Ontario.

The calanoid copepods Limnocalanus macrurus Sars and Senecella calanoides Juday are glacial relicts and, in northeastern North America, are confined to areas formerly occupied by glacial lakes or their spillways. Because they are usually observed in the hypolimnia of deeper lakes, they are considered cold stenotherms. It is also probable that neither of these large species would be able to survive in well-lit epilimnia under pressure from size-selective fish predators. Limnocalanus is known to undergo extensive diel vertical migrations; previous studies on migration of Senecella have been inconclusive because of small samples. Patterns of diel vertical migration of these two copepods, showed marked differences among four lakes in southern Ontario. It was hypothesized that diurnal and nocturnal vertical distributions of these two species reflect their vulnerability to planktivorous fish, which may include alewife (Aloss pseudoharengus), yellow whitefish (Coregonus clupeaformis), lake herring (Coregonus artedii), rainbow smelt (Oamerus mordax), yellow perch (Perca flavescens), trout-perch (Percopsis omiscomaycus), and rainbow trout (Salmo garidneri). Horizontal distributions of the two copepods also differed among four lakes: during early summer both species occurred in much shallower waters in lakes with low transparency than in clearer lakes. (Alexander-PPTT) W87-05054

PREDICTION OF EMERGENT AND FLOAT-ING-LEAVED MACROPHYTE COVER IN

CENTRAL SWEDISH LAKES,
North Carolina Univ. at Chapel Hill. Dept. of

No. 12, p 2519-2523, December 1986. 2 fg. 4 tab, 27 ref.

Descriptors: *Macrophytes, *Lake morphometry, *Nutrients, *Limnology, *Aquatic plants, *Mathematical studies, Regression analysis, Lakes, Prediction, Surface area, Depth, Cover, Vegetation, Ni-

The effects of nutrients and lake morphometry on the areal cover of floating-leaved and emergent macrophytes in lakes was examined using data from a survey of macrophyte vegetation in central Sweden. Multiple regression analysis of data from 22 lakes in the Uppland area suggest that the peak areal cover (hectares) of emergent vegetation is predictable from lake surface area, mean depth, and annual mean total nitrogen concentration in the lake water. The data also suggest that the percent cover of emergent macrophytes is predictable from mean depth and total nitrogen. However, the factors influencing floating-leaved macrophyte cover are not as clear. (Alexander-PTT) W87-05056

ARSENITE TOXICITY AND ARSENITE TOL-ERANCE IN THE CYANOBACTERIUM SYNE-CHOCOCCUS LEOPOLIENSIS, Queen's Univ., Kingston (Ontario). Dept. of Biol-

ogy.
For primary bibliographic entry see Field 5C.
W87-05058

ECOLOGICAL INTERPRETATION OF THE CHEMISTRY OF MIRE WATERS FROM SELECTED SITES IN EASTERN CANADA, Durham Univ. (England). Dept. of Botany. For primary bibliographic entry see Field 2K. W87-05061

2I. Water In Plants

PHOTOSYNTHESIS AND GROWTH OF WATER HYACINTH UNDER CO2 ENRICH-Florida Univ., Gainesville. Dept. of Botany.

For primary bibliographic entry see Field 2D. W87-04376

EFFECT OF ASULAM ON WATER POTENTIAL AND NITRATE REDUCTION,
Universidad del Pais Vasco, Bilbao (Spain). Dept. de Fisiologia Vegetal.
A. Munoz-Rueda, C. Gonzalez-Murua, J. M. Becerril, C. Arreseigor, and M. Sanchez-Diaz.
Plant Science PLSCE4, Vol. 46, No. 1, p 21-27, 1986. 5 fig, 28 ref.

Descriptors: *Enzymes, *Nitrate reduction, *Nitrates, , *Lucerne, *Clover, *Asulam, Stomata, *Leaves, *Water potentials, Herbicides.

Nitrate and nitrite reductase activities, stomatal response and water potential were measured in Medicago sativa (cv. Aragon) and Trifolium pratense (cv. Violeta) subjected to asulam (methyl(4-aminobenzenesulfonyl)carbamate concentrations of 0.15 mM, 1.5 mM, and 15 mM. The shoots of the 0.15 mM, 1.5 mM, and 15 mM. The shoots of the sulam-treated plants lost their turgidity since the fresh weight/dry weight ratio decreased and a decay of water potential was observed, and consequently stomatal resistance was increased. Asulam treatment (15 mM) induced 80% stomatal closure in both species after 7 days. The nitrate and nitrite reductase activities appeared to be very sensitive to this herbicide. In general, clover was more sensitive to asulam than lucerne. (Author's abstract) W87.04382

EFFECT OF SIMULATED WET SPRING CON-EFFECT OF SIMULATED WET SPRING CON-DITIONS ON THE RELATIVE EFFICIENCY OF THREE FORMS OF NITROGEN FERTIL-IZER ON GRASSLAND, Agriculture and Food Science Centre, Belfast (Northern Ireland). Agricultural and Food Chem-istry Research Div.

istry Research Div.
For primary bibliographic entry see Field 2D.
W87-04385

ROOT REGULATED WATER RELATION-SHIPS AND GROWTH OF GROUNDNUT

Andhra Pradesh Agricultural Univ., Hyderabad

(India). V. Ramesh Babu, and A. Nageswara Rao. Annals of Arid Zone ANAZBX, Vol. 24, No. 4, p 310-325, December 1985. 6 fig, 2 tab, 30 ref.

Descriptors: *Peanuts, *Groundnuts, *Plant growth, *Root system, *Plant water relations, Development, Vigor, Seedlings, Leaves, Seed grad-

An attempt was made to determine the effect of kernel size in groundnut on the development of seedling root and leaf areas and the range of variability in the physiological performance of individual groups of differing vigor with respect to root development, water relationships, and growth. Kernel (seed) regulated initial root and shoot development. The extent of the root system conditioned plant water relationships and growth. Variations due to initial seedling vigor were enhanced under drought conditions. A uniform stand of groundnut may be maintained by sowing a uniform grade of kernels. (Rochester-PTT)

RAIN-INDUCED DISPERSAL IN PUCCINIA ARACHIDIS, STUDIED BY MEANS OF A RAINFALL SIMULATOR, Office de la Recherche Scientifique et Technique Outre-Mer, Abidjan (Ivory Coast). Lab. de Phyto-

pathologie. For primary bibliographic entry see Field 2B. W87-04387

INTERCEPTION OF RAINFALL IN A HEDGE-ROW APPLE ORCHARD, Bristol Univ. (England). Dept. of Agricultural Sci-

For primary bibliographic entry see Field 2B. W87-04397

Water In Plants—Group 21

EXTRACTABILITY AND PLANT AVAILABIL-ITY OF MOLYBDENUM FROM INORGANIC AND SEWAGE SLUDGE SOURCES, Ohio State Univ., Columbus. For primary bibliographic entry see Field 5B. W87-04444

CELLULAR READJUSTMENT OF BARLEY SEEDLINGS TO SIMULATED ACID RAIN, Lancaster Univ., Bailrigg (England). Dept. of Bio-For primary bibliographic entry see Field 5C. W87-04474

ECONOMIC VALUE OF SEASONAL-PRECIPITATION FORECASTS: THE FALLOWING/PLANTING PROBLEM, Oregon State Univ., Corvallis. Dept. of Atmospheric Sciences.
For primary bibliographic entry see Field 2B. For primary bibliographic entry see Field 2B. W87-04521

LIGHT ADAPTATION AND THE ROLE OF AUTOTROPHIC EPIPHYTES IN PRIMARY PRODUCTION OF THE TEMPERATE SEAGRASS, ZOSTERA MARINA L. GRASS, ZUNTERA MARINA L., Stazione Zoologica di Napoli (Italy). L. Mazzella, and R. S. Alberte. Journal of Experimental Marine Biology and Ecol-ogy JEMBAM, Vol. 100, No. 1-3, p 165-180, Sep-tember 1986. 5 fig, 4 tab, 26 ref. NSF Grant OCE 82-14914.

Descriptors: *Light quality, *Wetland ecology, *Light adaptation, *Epiphytes, *Photosynthesis, *Seagrasses, *Primary production, *Great Harbor, Massachusetts, Pigment content, Chlorophyll.

Photosynthetic features of Zostera marina and its autotrophic epiphyte community were investigated in a population in the shallow water meadow in Great Harbor, Massachusetts. Photosynthesis versus irradiance (P-I) realtionships were measured with respect to leaf age determined by the leaf position in the shoot bundle and by location of the tissue along the leaf axis. The maximum photosynthesis per sq dm increased nearly two-fold along the leaf axis from leaf bases to apices. Photosynthetic rate on a chlorophyll (Chl) basis did not increase as dramatically along the leaf axis, and rates were lowest in tissues with the highest Chl content. The P-I relationships of leaves of different ages did not reveal photoinhibition even at light intensities > 1400 microE/4q m/s. No photoinhibition was observed in leaf blade bases, which never experienced high light levels in situ. The initial slopes of the P-I curves and light compensation and saturation values varied along the leaf axis in relation to leaf or tissue age. The contribution of the autotrophic epiphyte community of Z. marina leaves to total photosynthesis per sq dm was between 27 and 50%, and between 10 and 44% per mg chlorophyll. Non-epiphytized leaves and leaves from which epiphytes were removed showed essentially identical photosynthetic features. Light intensity and age gradients along the leaf axis control both the photosynthetic preformance of the leaves and epiphyte biomass and photosynthesis. (Author's abstract) Photosynthetic features of Zostera marina and its

SEASONAL PATTERNS OF GROWTH AND COMPOSITION OF PHYTOPLANKTON IN THE LOWER CHESAPEAKE BAY AND VICIN-Old Dominion Univ., Norfolk, VA. Dept. of Bioon Dominion Univ., Norfolk, VA. Dept. of logical Sciences. For primary bibliographic entry see Field 2L. W87-04611

PHOTOSYNTHETIC ACCLIMATION AND WATER-USE EFFICIENCY OF THREE SPECIES OF UNDERSTORY HERBACEOUS BAMBOO (GRAMINEAE) IN PANAMA, Pennsylvania Univ., Philadelphia. Dept. of Biology. For primary bibliographic entry see Field 2D.

W87-04651

TISSUE WATER RELATIONS OF FOUR CO-OCCURRING CHAPARRAL SHRUBS, Stanford Univ., CA. Dept. of Biological Sciences. S. D. Davis, and H. A. Mooney. Oecologia OECOBX, Vol. 70, No. 4, p 527-535, November 1986. 6 fig. 2 tab, 38 ref, append. NSF Grants BSR 831-5675 and SPI 816-5080.

Descriptors: *Water stress, *Chaparral shrubs, *Shrubs, *Water use efficiency, *Drought effects, *Tissue analysis, Plant morphology, Climates, Tolerance, Seasonal variation, Osmotic potential, Turgor, Soil moisture, Hygror

erance, Seasonal variation, Osmotic potential, Turgor, Soil moisture, Hygrometry.

Chaparral shrubs of California have a suite of morphological and physiological adaptations to withstand the prolonged summer droughts of a mediterranean climate. Not all species of chaparral have the same rooting depth and there is some evidence that those with shallow roots have tissue that is most tolerant to water stress. The tissue water relations of four co-occurring chaparral shrubs: Quercus durata, Heteromeles arbutifolia, Adenostoma fasciculatum, and Rhamnus californica were tested. A pressure-volume technique and a dew-point hygrometer were used to measure seasonal changes in osmotic potential when plant tissue was fully hydrated and osmotic potential at predawn, midday, and the turgor loss point. Seasonal changes in the minimum daily turgor potential, saturated weight/dry weight ratio of leaf tissue, and the bulk modulus of elasticity were calculated. All evidence indicated that Rhamnus had shallow roots and Quercus deep roots The results indicated that the tissue water relations of the four co-occurring chaparral shrubs were not alike. Even though Rhamnus had shallow roots, it had the least xerophylic tissue. Seasonal osmotic potential and saturated weight/dry weight ratios were relatively high and bulk modulus of elasticity and minimum daily turgor potentials were low. Furthermore, even though Quercus had deep roots and experienced no seasonal water stress at the study site, its tissue water relations indicated relatively high tolerance to water stress. It is concluded that seasonal drought tolerance of stem and leaf tissue of co-occurring chaparral shrubs does not necessarily correspond to rooting depth, to soil moisture resources available to the shrub, or to the degree of seasonal water stress experienced by the shrub. shrub. (Author's abstract) W87-04652

BIOMASS ACCUMULATION AND RESOURCE UTILIZATION IN CO-OCCURRING GRASS-LAND ANNUALS, Stanford Univ., CA. Dept. of Biological Sciences. For primary bibliographic entry see Field 2D. W87-04653

EFFECT OF SYNTHETIC DETERGENTS ON GERMINATION OF FERN SPORES, National Botanical Research Inst., Lucknow (India). For primary bibliographic entry see Field 5C. W87-04664

MEASUREMENT OF DRY DEPOSITION TO VEGETATIVE SURFACES, General Motors Research Labs., Warren, MI. For primary bibliographic entry see Field 5A. W87-04712

RECENT AND HISTORIC RED SPRUCE MORTALITY: EVIDENCE OF CLIMATIC INFLU-

Pennsylvania Univ., Philadelphia. Dept. of Land-scape Architecture and Regional Planning. For primary bibliographic entry see Field 5C. W87-04725

FOLIAGE TEMPERATURE: EFFECTS OF EN-VIRONMENTAL FACTORS WITH IMPLICA-TIONS FOR PLANT WATER STRESS ASSESS-MENT AND THE CO2/CLIMATE CONNEC-

Agricultural Research Service, Phoenix, AZ. Water Conservation Lab. For primary bibliographic entry see Field 2D. W87-04760

IONIC COMPOSITION OF ISOETES SETA-CEA PLANTS DURING REACTIVATION BY REHYDRATION, (LES TENEURS IONIQUES DES PLANTS D'ISOETES SETACEA AU COURS DE LA REACTIVATION PAR REHY-DRATATION DRATATION).

Paris-6 Univ. (France). Lab. de Cytologie et Mor-phogense Vegetales. N. Michaux-Ferriere.

Canadian Journal of Botany CJBOAW, Vol. 64, No. 10, p 2171-2177, October 1986. 5 fig, 6 tab, 26

Descriptors: *Rehydration *Water stress, *Drought resistance, *Ions, *Tissue analysis, *Isoetes, *Plant physiology, Calcium, Potassium, Sulfur, Phosphorus, Magnesium, Apical meristem, Cortex, Central Stele, Plant growth, Metabolism.

Ionic amounts of S, P, K(+), Ca(2+), and Mg(2+) were determined chemically in different parts of Isoetes setacea (shoot apical meristem, cortical zone, and central stele) for plants in normal growth, in drought resistance, and during rehydration. Study of modifications in ionic amounts during experimental rehydration showed that the significant increase of K(+), Ca(2+), and Mg(2+) by the 24th rr of experimentation was one of the earliest signals observed for the cells of the apical meristem (which are at that time blocked in G1 presynthesis phase) as well as for the differentiated cells. By the 7th day of rehydration, just before their entrance into the synthesis phase, meristematic cells have recovered ionic rates equivatematic cells have recovered ionic rates equivalent to those measured in active plants. The same thing happens in the nonmeristematic tissues. This increase of ionic amounts in the whole plant can be explained by a differential entrance of ions with water. This new balance of the ionic amounts water. This new outlance of the former amounts according to the pattern found in the active plants can be considered as a prerequisite event for the recovery of an active metabolism for a meristematic or differentiated cell in water stress. (Author's W87-04818

DEGRADATION OF SPARTINA LIGNOCEL-LULOSE BY INDIVIDUAL AND MIXED CUL-TURES OF SALT-MARSH FUNGI, George Mason Univ., Fairfax, VA. Dept. of Biol-Ogv. For primary bibliographic entry see Field 5C.

W87-04819

EFFECTS OF DRILLING FLUIDS ON THA-LASSIA TESTUDINUM AND ITS EPIPHYTIC ALGAE, University of West Florida, Pensacola. Dept. of

Biology. For primary bibliographic entry see Field 5C. W87-04825

EFFECTS OF ACIDITY OF SIMULATED RAIN AND ITS INFLUENCE ON THE PHYTOTOXI-CITY OF CHLORSULFURON ON VELVET-LEAF AND BARLEY,

Virginia Polytechnic Inst. and State Univ., Blacks-burg. Dept. of Plant Pathology and Physiology. For primary bibliographic entry see Field 5C. W87-04826

COMPARATIVE STUDY OF DECOMPOSI-TION, OXYGEN CONSUMPTION AND NU-TRIENT RELEASE FOR SELECTED AQUATIC PLANTS OCCURRING IN AN ESTUARINE EN-VIRONMENT,

Maryland Univ., Cambridge. Horn Point Environ-mental Labs. For primary bibliographic entry see Field 2L. W87-04833

Field 2-WATER CYCLE

Group 21-Water In Plants

INFLUENCE OF SOME PHYSICO-CHEMICAL FACTORS ON CADMIUM UPTAKE BY THE GREEN ALGA STICHOCOCCUS BACILLARIS, Polish Academy of Sciences, Zabrze. Inst. of Environmental Engineering.

Por primary bibliographic entry see Field 5G.

INFLUENCE OF MOISTURE STRESS AND IN-DUCED RESISTANCE IN PONDERSOSA PINE, PINUS PONDERSOSA DOUGL. EX. LAWS, ON THE PINE SAWFLY, NEODIPRION AUTUMNALIS SMITH,

ern Arizona Univ., Flagstaff. School of For-

For primary bibliographic entry see Field 2D. W87-04851

EFFECT OF HYDROPHILIC POLYMER ON MEDIA WATER RETENTION AND NUTRIENT AVAILABILITY TO LIGUSTRUM LUCIDUM, Clemson Univ., SC. Dept. of Horticulture. For primary bibliographic entry see Field 3F. W87-04858

EVIDENCE FOR THE PARTICIPATION OF DISSIMILATORY PROCESSES IN MAINTAINING HIGH CARBON FLUXES THROUGH THE PHOTOSYNTHETIC CARBON REDUCTION AND OXIDATION CYCLES IN WATER STRESSED PHASEOLUS LEAVES, Kaiseralautern Univ. (Germany, F.R.). Fachbereich Biologie.
FOR primary bibliographic entry see Field 210.

For primary bibliographic entry see Field 2D. W87-04867

PHOTOSYNTHETIC RATE AND WATER RE-LATIONS IN SOME FOREST HERBS IN SPRING AND SUMMER, Slovenska Akademia Vied, Bratislava (Czechoslovakia). Ustav Experimentalenj Biologie a Ekolo-

gge. E. Masarovicova, and P. Elias. Photosynthetica PHSYB5, Vol. 20, No. 2, p 187-195, 1986. 4 fig. 4 tab, 19 ref.

Descriptors: *Photosynthesis, *Drought effects, *Water use, *Herbs, *Seasonal variation, Plant tis-sues, Leaves, Plant water potential, Irradiation, Carbon dioxide, Conductance.

Carbon dioxide, Conductance.

Different net photosynthetic rates and water relations characteristics were analyzed for three syring ephemeroides and two summer species growing in the forest in spring and summer. Measurements in the forest were completed by measurements of irradiation response curves for carbon dioxide uptake in controlled conditions. In spring, early spring ephemeroides and hemi-ephemeroides awell as young leaves of summer species had a high net photosynthetic rate and stomatal conductance. In summer, in the mature leaves of two summer species, lower values for maximum photosynthetic rate and stomatal conductance were found. Under hard drought and very high temperature, only respiration and very low stomatal conductance were found. Maximal net photosynthetic rate and stomatal conductance were found in the morning before maximal water saturation deficit values were reached. Water relations and carbon dioxide exchange in forest herbs were strongly affected by moving sunflecks. Higher net photosynthetic rate and stomatal conductance and lower leaf water potential were found in sunlight than in the shade. Short term irradiance changes caused significant aet photosynthetic rate changes. Differences were found in the irradiation response of net photosynthetic rate between spring (sun) plants and summer leaves of the summer species. High specific leaf mass and low specific leaf area were found in the summer species. (Author's abstract)

W87-04868

DROUGHT AND TROPICAL PASTURE MAN-Maiduguri Univ. (Nigeria). Dept. of Crop Science.

For primary bibliographic entry sr. . . . eld 3F. W87-04869

INFLUENCE OF SOIL WATER REGIMES ON VA MYCORRHIZA. IV. EFFECT ON ROOT GROWTH AND WATER RELATIONS OF SOR-GHUM BICOLOR, Goettingen Univ. (Germany, F.R.). Inst. fuer Pflanzensia.

Prinargenosu.

E. Sieverding.

Journal of Agronomy and Crop Science

ZAPFAR, Vol. 157, No. 1, p 36-42, July 1986. 4
tab, 18 ref.

Descriptors: *Water stress, *Drought resistance, *Soil water, *Sorghum, *Root development, Plant growth, Morphology, Phosphorus.

Non-mycorrhizal and mycorrhizal plants of Sorghum bicolor were grown at three water regimes in a greenhouse experiment. Root length and root morphology of were monitored in two soils for 34 days. From 29 days on, total root length of mycorrhizal sorghum was greater than that of non-mycorrhizal sorghum in moderate and high water stress conditions. In one soil, a lower percentage of coarse roots and smaller root length per leaf area were found with mycorrhizal plants. In another soil, this was only the case with well watered conditions. In general, all root and water relation parameters were less affected by water stress when plants were mycorrhizal. This sensitivity of mycorrhizal sorghum may increase the tolerance of the plant to drought. However, water relations of plants were indirectly enhanced by mycorrhiza via increased phosphorus uptake. (Author's abstract) W87-04870 Non-mycorrhizal and mycorrhizal plants of Sor-

WATERMELON (CITRULLUS LANATUS)
PRODUCTION UNDER MULCH AND TRICK-LE IRRIGATION IN THE JORDAN VALLEY, Jordan Univ., Amman.
For primary bibliographic entry see Field 2D.
W87-04877

PHYSIOLOGICAL BASIS OF IRRIGATION SCHEDULING FOR SEED PRODUCTION IN EGYPTIAN CLOVER SYN. BERSEEM (TRIFOLIUM ALEXANDRINUM L.) CROP,

Indian Grassland and Fodder Research Inst. Jhansi. For primary bibliographic entry see Field 3F.

INFECTION WITH POWDERY MILDEW CAN INFECTION WITH POWDERY MILDEW CAN
ENHANCE THE ACCUMULATION OF PROLINE AND GLYCINEBETAINE BY SALT
STRESSED BARLEY SEEDLINGS,
Lancaster Univ., Bailrigg (England). Dept. of Biological Sciences. For primary bibliographic entry see Field 3C. W87-04888

TECHNIQUE FOR ECOLOGICAL STUDIES OF SEED GERMINATION IN RELATION TO SOIL. WATER POTENTIAL, University Coll., Cork (Ireland). Dept. of Plant

J. R. Etherington, and C. E. Evans. Plant and Soil PLSOA2, Vol. 95, No. 2, p 285-288, 1986. 1 fig, 9 ref.

Descriptors: "Water potentials, "Germination, "Seeds, "Soil water potential, "Soil-water-plant relationships, Carbon dioxide, Soil types, Culture media, Ecology.

Seeds were germinated in soils of known matric potential achieved by adding the requisite amount of water to air-dry soil and mixing for several days. The quantity of water was derived from calibration curves of water content against psi sub m by use of pressure-plate extraction equipment. Soils were transferred to plastic Petri dishes in which seeds were sown. Variations of the technique permitted germination counting through the transferred. mitted germination counting through the transpar ent dish lid, or by opening the dish and either resealing or discarding the replicate dish. Measure

ments of ethylene and carbon dioxide in the soil atmosphere suggest that neither gas accumulated to a level which could interfere with interpretations of results. Some species showed sensitivity of germination to water potential which was correlat-ed with the relative wetness of their habitats. (Austract)

RELATIONSHIPS BETWEEN WATER STRESS AND ULTRASOUND EMISSION IN APPLE (MALUS X DOMESTICA BORKH.), East Malling Research Station, Maidstone (Eng-land). Plant Physiology Dept. H. G. Jones, and J. Pena. Journal of Experimental Botany, Vol. 37, No. 181, p 1245-1254, August 1986. 4 fig, 1 tab, 24 ref.

Descriptors: "Hardwood, "Water stress, "Ultrasonics, "Apples, "Cavitation, "Plant water potential, "Irrigation efficiency, Drying, Trees, Leaves, Water potentials, Irrigation, Stress, Flow.

water potentials, Irrigation, Stress, Flow.

The relationships between ultrasound emissions (AEs) and water relations were investigated in both potted and field-grown apple trees. AEs were more frequent in unirrigated than in irrigated trees. Evidence suggests that AEs are related to cavitation events in the xylem vessels. The threshold for occurrence of AEs was approximately -1.0 MPa in all types and sizes of tree studied, falling to -2.0 MPa or lower after a period of water stress. Ultrasound emissions were much more frequent during an initial drying to about -3.0 MPa than in a second drying cycle after rehydration. The reduction in AEs during the second drying cycle was more than expected from a comparison of the magnitude of water loss in the two cycles. The cross sectional area of wood that was conducting was markedly reduced by a single drought to -3.0 MPa. Drilling into the stem at different distances from the sensor provided further evidence that AEs represent cavitation events. (Author's abstract)

EFFECTS OF OSMOTIC POTENTIAL IN NUTRIENT SOLUTION ON DIURNAL GROWTH OF TOMATO FRUIT, shouse Crops Research Inst., Littlehampton

D. L. Ehret, and L. C. Ho. Journal of Experimental Botany, Vol. 37, No. 182, p 1294-1302, September 1986. 2 fig. 5 tab, 20 ref.

Descriptors: *Osmotic pressure, *Culture media, *Diurnal distribution, *Plant growth, *Tomatoes, *Nutrients, *Plant physiology, Salinity, Conductivity, Distribution, Growth, Fruit crops, Humidity, Transpiration.

ty, Transpiration.

Tomato fruit on plants grown in circulating nutrient solution were found to exhibit a diurnal cycle in growth rate, measured as a change in diameter, with a maximum during the day. The diurnal growth cycle was less evident in those fruit grown at high electrical conductivity (17 mS), or on days of reduced irradiance. Circlied fruit of low conductivity plants grew at a much reduced rate with a diurnal cycle in reverse to that of ungirdled fruit, while girdled fruit of high conductivity plants showed no diurnal growth. The evidence suggests that phloem and xylem water transport into fruit operate on opposite diurnal cycles. Partitioning of available xylem water in detached fruit between the calyx and berry, as well as within the berry, was determined by berry size and relative humidity in the air. Although berry transport sito fruit growth, water uptake capacity was greatly reduced in the berry from high conductivity plants, suggesting an increased resistance in the xylem transport system within the fruit. (Author's abstract)

WATER MANAGEMENT EFFECTS ON N-USE

WATER MANDSUGARBEETS, BY CORN AND SUGARBEETS, Agricultural Research Service, Mandan, Northern Great Plains Research Center. For primary bibliographic entry see Field 3F. Mandan, ND.

W87-04932

EFFICIENT IRRIGATION TIMING METHODS FOR CORN PRODUCTION, North Dakota State Univ., Fargo. Dept. of Agri-cultural Engineering. ineering.
bibliographic entry see Field 3F.

ESTIMATING THE EFFECTS OF UNDER-STORY REMOVAL FROM A DOUGLAS FIR POREST USING A TWO-LAVER CANOPY EVAPOTRANSPIRATION MODEL, British Columbia Univ., Vancouver. Dept. of Soil ary bibliographic entry see Field 2D.

ECOLOGICAL STUDIES IN SOME PONDS OF OSMANIA UNIVERSITY CAMPUS WITH SPE-CIAL REFERENCE TO BOTTOM LIVING ALGAE: I. PHYSICO-CHEMICAL FACTORS, ania Univ., Hyderabad (India). Dept. Botany. For primary bibliographic entry see Field 2H. W87-05000

RESPONSE OF SELECTED SALT-TOLERANT AND NORMAL LINES OF FOUR GRASS SPE-CIES TO NACL IN SAND CULTURE, Liverpool Univ. (England). Dept. of Botany. M. Ashraf, T. McNeilly, and A. D. Bradshaw. New Phytologist NEPHAV, Vol. 104, No. 3, p 453-461, November 1986. 2 fig, 4 tab, 19 ref.

Descriptors: *Water pollution effects, *Crop yield, *Plant physiology, *Salinity, *Grasses, *Sodium chloride, *Salt tolerance, Sand, Salts, Dry matter, Sectivity, *Grasses, *Social Royal development, Selectivity.

Seedlings, Roots, Root development, Selectivity.

After seven weeks' growth in varying NaCl concentrations in sand culture, dry matter production and tiller number were compared for the progenies of NaCl-tolerant selection lines and the progenies of unselected control lines of Holcus lanatus L., Lolium perenne L., Dactylis glomerata L., and Festuca rubra L. The tolerant lines had been produced by selection at the seedling stage. In each species, selected lines produced significantly more dry matter and had greater tiller numbers than unselected material, particularly at high levels of NaCl. Shoot/root ratios differed significantly only in L. perenne, unselected material having higher shoot/root ratio. These data confirm that for these four species, selection based upon differences in seedling root growth is a valid means of selecting for improved NaCl tolerance in adult plants, and that this tolerance does not lead to any reduced performance in the absence of NaCl. (See also W87-05007) (Author's abstract)

W87-05006

RESPONSE TO NACL AND IONIC CONTENT OF SELECTED SALT-TOLERANT AND NORMAL LINES OF THREE LEGUME FORAGE SPECIES IN SAND CULTURE, Liverpool Univ. (England). Dept. of Botany. M. Ashraf, T. McNeilly, and A. D. Bradshaw. New Phytologist NEPHAV, Vol. 104, No. 3, p 463-471, November 1986. 6 fig. 2 tab, 15 ref.

Descriptors: *Forages, *Crop yield, *Tissue analysis, *Plant physiology, *Salinity, *Legumes *Sodium chloride, *Ions, *Salt tolerance, Sand Dry matter, Salinity, Selectivity.

Selected NaCl-tolerant lines of Trifolium alexandrinum L., Medicago sativa L., and Trifolium pratense L. produced significantly greater dry matter than unselected control lines after four weeks of growth in sand culture with different NaCl concentrations. Tolerant lines of all three species generally contained less Na(+) but more Cl(-) in their shoots than the normal lines, although these differences were not statistically significant. Selected lines also contained less K(+) in their shoots than unselected lines. Ca(2+) distribution was similar in T. alexandrinum and M. sativa but not in T. pra-

tense, in which the tolerant line had significantly higher Ca(2+) in the shoot than the unselected line. (See also W87-05006) (Author's abstract) W87-05007

EFFECTS OF SIMULATED ACID RAIN ON GERMINATIVE CAPACITY, GROWTH AND MORPHOLOGY OF FOREST TREE SEED-Maritimes Forest Research Centre, Fredericton (New Brunswick). For primary bibliographic entry see Field 5C. W87-05008

VEGETATION PATTERNS IN AND AMONG PANNES (CALCAREOUS INTRADUNAL PONDS) AT THE INDIANA DUNES NATION-AL LAKESHORE, INDIANA, Indiana Dunes National Lakeshore, Porter, IN. For primary bibliographic entry see Field 2H. W87-05030

EFFECTS OF WATER STRESS ON THE OR-GANIC ACID AND CARBOHYDRATE COM-POSITIONS OF COTTON PLANTS, Agricultural Research Service, New Orleans, LA. Southern Regional Research Center. J. D. Timpa, J. J. Burke, J. E. Quisenberry, and C. W. Wendt. Plant Physiology PLPHAY, Vol. 82, No. 3, p 724-728, November 1986. 5 tab, 15 ref.

Descriptors: *Water stress, *Organic acids, *Carbohydrates, *Cotton, *Evapotranspiration, *Plant physiology, Irrigation, Tissue analysis, Citric acid, Metabolism, Sugars, Performance evaluation Chromatography, Translocation, Wilting, Field tests, Drought resistance.

Drought resistance.

Organic acids and carbohydrates have been implicated in various roles in the metabolic and physiological responses of plants to water stress. Two photoperiodic cotton (Gossypium hirsutum L.) strains (T183 and T466) which had been empirically selected because of poor performance and two strains (T25 and T256) selected because of enhanced performance under field water stress were evaluated for stress-induced changes in their organic acids and carbohydrates. Profiles and quantitation of organic acids and carbohydrates from aqueous extractions of cotton leaf tissue were determined by high performance liquid chromatography. In all cases, the water-stressed plants showed two to five times greater amounts of organic acids and carbohydrates over the values determined for the irrigated samples. Under stress, sucrose accumulation was observed in wilting strains (poor performers) probably related to rate of translocation out of the leaf. The most dramatic response to water stress was the accumulation of citric acid in strains T25 and T256 as compared to T185 and T466. (Alexander-were those of T185 and T466. (Alexander-were the control to the control that of ed and water-stressed samples of T25 and T256 were twice those of T185 and T466. (Alexander-PTT) W87-05038

OSMOTIC ADJUSTMENT IN LEAVES OF VA MYCORRHIZAL AND NONMYCORRHIZAL ROSE PLANTS IN RESPONSE TO DROUGHT

RUSE FLANTS IN RESPONSE ACCEPTANTS IN RESPONSE ACCEPTANTS IN RESPONSE ACCEPTANTS IN AUGUST AND ACCEPTANT AND ACCEP

Descriptors: *Osmotic adjustment, *Drought effects, *Water stress, *Plant water potential, *lant physiology, *Evapotranspiration, Acclimatization, Fungi, Roses, Soil water potential, *Sporulation, Reproduction, Water deficit, Turgor, Osmosis.

Recent evidence suggests that colonization of root systems by VA mycorrhizal fungi affords host plants greater resistance to drought stress. Mycorr-hizal plants may avoid drought to some extent through enhanced water uptake at low soil mois-

ture levels. Osmotic adjustment in Rosa hybrida L. cv Samantha was characterized by the pressure-volume approach in drought-acclimated and unacclimated plants brought to the same level of drought strain, as assayed by stomatal closure. Plants were colonized by either of the venicular-arbuscular mycorrhizal fungi Glomus deserticola. Trappe, Blosa and Menge or G. intraradices Schenck and Smith, or were nonmycorrhizal. Both the acclimation and the mycorrhizal treatments decreased the osmotic potential (Pai sub Pi) of leaves at full turgor and at the turgor loss point, with a corresponding increase in pressure potential at full turgor. Mycorrhizae enabled plants to maintain leaf turgor and conductance at greater tissuewater deficits, and lower leaf and soil water potentials, when compared with nonmycorrhizal plants. As indicated by the Psi sub pi at the turgor loss point, the active Psi sub pi depression which attended mycorrhizal colonization alone was 0.4 to 0.6 megapascals, relative to unacclimated controls without mycorrizae. Colonization levels and sportulation were higher in plants subjected to acclimation. In unacclimated hosts, leaf water potential, water saturation deficit, and soil water potential at a particular level of drought strain were affected most by G. intraradices. G. deserticola had the greater effect after drought preconditioning. (Alexander-PTT) W87-05039 ander-PTT) W87-05039

PHOTOSYNTHETIC RESPONSES OF LEAVES TO WATER STRESS, EXPRESSED BY HO-TO ACCOUSTICS AND RELATED METHODS: I. PROBING THE PHOTOACOUSTIC METHOD AS AN INDICATOR FOR WATER STRESS IN VIVO, Weizm

in Inst. of Science, Rehovoth (Israel). Dept. of Biochemistry.
M. Havaux, O. Canaani, and S. Malkin.
Plant Physiology PLPHAY, Vol. 82, No. 3, p 827-833, November 1986. 10 fig, 1 tab, 29 ref. BARD Grant I-338-81.

Descriptors: "Photosynthesis, "Water stress, "Measuring instruments, "Photoscoustics, "Plant physiology, Diffusion, Evapotranspiration, Performance evaluation, Chloroplasts, Cells, Isolation, Tobacco, Dessication, Leaves.

Tobacco, Dessication, Leaves.

The effect of leaf desiccation on the photosynthetic activities in vivo was probed by the photoacoustic method to: (a) study the photoacoustic in the control of the photoacoustic in the control of the The effect of leaf desiccation on the photosynthet-

Field 2-WATER CYCLE

Group 21-Water in Plants

PHOTOSYNTHETIC RESPONSES OF LEAVES TO WATER STRESS, EXPRESSED BY PHO-TOACOUSTICS AND RELATED METHODS: II. THE EFFECT OF RAPID DROUGHT ON THE ELECTRON TRANSPORT AND THE RELATIVE ACTIVITIES OF THE TWO PHOTOSYS-

Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Biochemistry.

Dept. of Biochemistry.

M. Havaux, O. Canaani, and S. Malkin.

Plant Physiology PLPHAY, Vol. 82, No. 3, p 834-839, November 1986. 7 fig. 3 tab, 32 ref, append.

BARD Grant I-338-81.

Descriptors: *Photosynthesis, *Water stress, *Pho-toacoustics, *Measuring instruments, *Drought ef-fects, *Electron transport, *Evapotranspiration, Tobacco, Leaves, Plant physiology, Chlorophyll a,

The effect of rapid dehydration of detached tobacco leaves (Nicotiana tabacum L.) on the photochemical apparatus of photosynthesis was studied as vivo by a combination of methods: photoacoustics, chlorophyll a fluorescence, and cytochrome f difference spectroacopy. It was shown that the inhibition of gross O2 evolution was mainly caused by inactivation of PSH: (a) The saturation curve of cytochrome-f photoaxidation by far-red (>710 mm) light was resistant to the stress, leading to the conclusion that photosystem II (PSI) was largely unaffected by the stress. (b) The extent of the chlorophyll a variable fluorescence arising from photosystem II (PSII) decreased with the progression of the stress, but was largely unaffected when photosystem II (PSII) decreased with the progres-sion of the stress, but was largely unaffected when the leaf was preincubated with electron donors to PSII, such as hydroxylamine. It is concluded that the drought damage to PSII occurred on the pho-tooxidative side. Despite the extensive inhibition of PSII and the relative preservation of PSI, the apparent PSII/PSI activity balance was somewhat larger in stressed leaves than in the control. Meassager is stressor leaves than in the control. Mean-urements were performed continuously under con-ditions which favor transitions to either state 1 or 2, showing that the transition to state 2 was consid-erably inhibited. Simultaneous measurements of chlorophyll fluorescence induction at 680 and 730 nm at room temperature were also used to probe changes in energy distribution between PSII and PSI and indicated that the transition from a dark adapted state to state 2 was also affected in water-stressed leaves. The saturation curve of the far-red stressed leaves. In a saturation curve of the learner light effect in Emerson enhancement was not changed by the stress, giving another independent evidence for the drought resistance of PSI activity. This apparent preservation of the imbalance in photochemical activities in favor of PSII, despite the fact that PSII is strongly inhibited, and PSI is not, supports a previous suggestion that the electron transfer between the two photosystems is no random but that a large extent of PSII and PSI units are specifically linked. (See also W87-05040) (Author's abstract)

PREDICTION OF EMERGENT AND FLOAT-ING-LEAVED MACROPHYTE COVER IN CENTRAL SWEDISH LAKES,

North Carolina Univ. at Chapel Hill. Dept. of For primary bibliographic entry see Field 2H.

VEGETATION-ELEVATION CORRELATION IN TWO DYKED MARSHES OF NORTHEAST-ERN VANCOUVER ISLAND: A MULTIVAR-IATE ANALYSIS.

British Columbia Univ., Vancouver. Dept. of

For primary bibliographic entry see Field 2L.

NONSTEADY-STATE ANALYSIS OF WATER FLOW AND CAPACITANCE FOR AGAVE DE-

California Univ., Los Angeles. Dept. of Biology. For primary bibliographic entry see Field 2D.

VEGETATION COLONIZING THE BED OF A RECENTLY DRAINED THERMOKARST LAKE (ILLISARVIK), NORTHWEST TERRITORIES, Toronto Univ. (Ontario). Div. of Life Sciences. L. Ovenden.

Canadian Journal of Botany CJBOAW, Vol. 64, No. 11, p 2688-2692, November 1986. 3 fig, 1 tab,

Descriptors: *Drained lakes, *Thermokarst lakes, *Lake beds, *Vegetation, *Colonization, Species composition, Erosion, Wetness, Ponds, Lakes, Canada, Substrates, Distribution.

Illisarvik is the site of a thermokarst lake that was artificially drained in August 1978. The lake bed is now dry in most areas and wind erosion is extensive. The surface material is either sandy peat or sive. The surface material is either sandy peat or organic lake mud, except along the eastern margin, where it is sandy. Substrate type appears to have had little influence on distributional patterns of the toolonizing vegetation. More important factors are probably erosion, surface wetness, and proximity of the lake-bed margin. Common on the lake bed are Puccinellia borealis and Arctagrostis latifolia. Other widespread species include Senecio congestus, Carex aquatilis, Descurainia sophioides, Matricaria ambigua, Artemisia tilesii, Arctophila fulva, and Stellaria longipes. Senecio and Arctophila form dense stands around the two small residual ponds. Eroded surfaces have a very scant cover of Descurainia seedlings and Puccinellia tussocks. Many elements of Illisarvik's flora are common to other recently disturbed sites near the Arctic coast of northwestern North America. (Author's abstract) stract) W87-05062

2J. Erosion and Sedimentation

DEVICE FOR SAMPLING THE MUD-WATER INTERFACE IN EUTROPHIC LAKES AND BOGS FOR RESIDUE ANALYSIS Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences. For primary bibliographic entry see Field 7B. W87-0438

MONITORING OF ABIOTIC COMPART-MENTS FOR TRACE METALS: DIFFICUL-TIES, STRATEGIES AND USE OF SURVEYS, Nederlands Inst. voor Onderzoek der Zee, Texel-For primary bibliographic entry see Field 7B. W87-04384

MEANDER FLOW MODEL I: DEVELOP-Iowa Univ., Iowa City. Dept. of Civil Engineer-For primary bibliographic entry see Field 2E. W87-04388

MEANDER FLOW MODEL II: APPLICA-Iowa Univ., Iowa City. Dept. of Civil Engineer-For primary bibliographic entry see Field 2E. W87-04389

SEDIMENT CONTROL BY SUBMERGED

Iowa Univ., Iowa City. Dept. of Civil Engineering. A. J. Odgaard, and A. Spoljaric. Journal of Hydraulic Engineering JHEND8, Vol. 112, No. 12, p 1164-1181, December 1986. 11 fig,

Descriptors: *Sediments, *Submerged vanes, *Alluvial channels, *Channel flow, *Channel improvement, *Design standards, *Sediment control, Nearbed velocity, Scour, Momentum equations.

A procedure was developed for a rational design of a system of submerged vanes for depth control in alluvial-river channels. The vanes were vertical, small-aspect ratio foils installed on the channel bed

at an angle of attack of 10-15 degrees with the flow. Their height was 0.2-0.5 times the water depth at design flow (stage). The design procedure was based on a calculation of the transverse bed slope generated by the vane-induced transverse component of the near-bed velocity vector. The streamwise extent of the vanes' impact was governed by the momentum equation. The effectiveness of the technique was tested in a series of laboratory experiments. The most important finding was that a vane system designed according to the guidelines given, produced changes in flow depth by transporting sediment sideways rather than downstream so that the overall channel characteristics were not changed. These vanes also did toan downstream so that the overall channel characteristics were not changed. These vanes also did not change the channel's cross-sectional area. The findings suggest that the submerged-vane structure may be an effective, economic, low-maintenance, and environmentally acceptable sediment-control structure with a wide range of applications. (Wood-PTT) W87-04391

CALCITE PRECIPITATION IN LAKE CON-STANCE: CHEMICAL EQUILIBRIUM, SEDI-MENTATION, AND NUCLEATION BY ALGAE, Konstanz Univ. (Germany, F.R.). Limnological

For primary bibliographic entry see Field 2H. W87-04432

HORIZONTAL SEDIMENTATION DIFFER-ENCES IN A EUTROPHIC SWISS LAKE, Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Due-bendorf (Switzerland). Inst. of Aquatic Sciences. For primary bibliographic entry see Field 2H. W87-04433

GEOCHEMICAL CHARACTERIZATION OF SUSPENDED PARTICLES IN ESTUARINE AND COASTAL SEAWATER BY X-RAY FLUORESCENCE SPECTROMETRY, Tokyo Univ. (Japan). Dept. of Chemistry. For primary bibliographic entry see Field 2L. W87-04467

CONCAVE-BANK BENCHES IN THE FLOOD-PLAINS OF MUSKWA AND FORT NELSON RIVERS, BRITISH COLUMBIA. n Fraser Univ., Burnaby (British Columbia).

E. J. Hickin. tian Geographer CNGGAR, Vol. 30, No. 2, -122, Summer 1986. 11 fig, 19 ref.

Descriptors: *Flood plains, *Channel morphology, *Concave bank benches, *Sedimentation, *Meanders, *Banks, *Deposition, Flow channels, Bottomland, Muskwa River, Nelson River, British Columbia, Oxbow lakes, Glacial lakes, Lakes, Morphology, Lake morphology, Sediments, Lake sediments, Glacial sediments.

Floodplain features deposited in separated flow on the concave side of river bends of tight curvature are studied. Although concave-bank benches seldom occur in freely meandering rivers, they can constitute a significant proportion of the floodplain formed by the downvalley migration of the tight channel bends of confined meanders. The results of this field survey of the floodplains of Fort Nelson and Muskwa rivers, two British Columbian rivers whose meandering is limited to the resistant valley sides of former glacial meltwater channels. The formation and character of contemporary concavesides of former glacial meltwater channels. The formation and character of contemporary concavebank benches and the morphology and sediments of the corresponding floodplain features are described. The concave-bank benches form lateral ribbons of deposition along the valley walls and constitute about one-third of the entire floodplain. (Author's abstract)
W87-04522

ALPHA-EMITTING, HOT PARTICLES IN IRISH SEA SEDIMENTS, Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Directorate of Fisheries Re-

Erosion and Sedimentation—Group 2J

For primary bibliographic entry see Field 5B. W87-04567

NICKEL-63 IN COLUMBIA RIVER SEDI-MENTS BELOW THE HANFORD RESERVA-

Oregon State Univ., Corvallis. School of Oceanography.
For primary bibliographic entry see Field 5B.
W87-04577

SEDIMENT BALANCE IN SUSPENDED SEDIMENT BALANCE IN CHANGJIANG ESTUARY, National Bureau of Oceanography, Hangzhau (China). Second Inst. of Oceanography. For primary bibliographic entry see Field 2L. W87-04610

REVIEW OF THE CHEMICAL RECORD IN LAKE SEDIMENT OF ENERGY RELATED AIR POLLUTION AND ITS EFFECTS ON LAKES, Maine Univ. at Orono. Dept. of Geological Sci-

For primary bibliographic entry see Field 5B. W87-04726

NEW DATA FROM PEAT BOGS MAY GIVE A HISTORICAL PERSPECTIVE ON ACID DEPO-

Pittsburgh Univ., PA. Graduate School of Public

Ne. R. Schell, A. L. Sanchez, and C. Granlund. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 393-409, September 1986. 3 fig, 2 tab, 16

Descriptors: *Acid rain, *Peat bogs, *Acid deposi-tion, *Fate of pollutants, *Water pollution sources, *Sediment cores, *Pollutant identification, History, Trace elements, Peat, Bogs, Fallout, Isotopes, Ac-cumulation, Transport, Enrichment.

The global problem of man's input of toxic chemi-cals on ecosystems has shown up in recent years in fish kills, reduction and loss of forests, and destruc-tion of buildings, roads and monuments. Dynamic changes in certain bog ecosystems together with environmental trace elements may be utilized to atmospheric chemicals environmental trace elements may be utilized to reconstruct the history of atmospheric chemicals deposited on the terrestrial biosphere. Cores col-lected from ombrotrophic bogs in eastern New York, western Pennsylvania and western Virginia York, western Pennsylvania and western Virginia were dated using the Pb-210 method and analyzed for 34 elements by neutron activation analysis. The fallout Cs-137 profiles were utilized to cross check the Pb-210 dates assigned for each layer and to estimate the transport of mobile elements similar to Cs. A comparison has been made between the relative enrichment factors of the elements accumulated at different times since 1800 on the dated peat bog layers and the crustal abundance of elements compared to Al. At the PA site, relative enrichments of greater than 100 times are found for Cl, N, S and Br; relative enrichments of 10 to 40 times are found for Pb, Ca and Sb. At the NY site, generally lower relative enrichments are found with values of 10 to 40 times for Cl, Cr, and Mn and less than 10 times for N and S. (Alexander-PTT). PIT W87-04732

POLLUTED PRECIPITATION AND THE GEOCHRONOLOGY OF MERCURY DEPOSI-TION IN LAKE SEDIMENT OF NORTHERN MINNESOTA, Group for the South Fork, Inc., Bridgehampton,

NY. For primary bibliographic entry see Field 5B. W87-04733

DISTRIBUTION OF METALS IN DIFFERENT SIZE FRACTIONS OF SEDIMENT FROM THE

SIZE FRACTIONS OF SEDIMENT FROM THE NIAGARA RIVER, National Water Research Inst., Burlington (Ontar-io). Environmental Contaminants Div. For primary bibliographic entry see Field 5B. W87-04746

VALLEY TERRACES AND LAKE ALGONQUIN SHORELINE POSITION, SOUTHEAST SHORE OF LAKE HURON, CANADA, Waterloo Univ. (Ontario). Dept. of Earth Sciences.

P. F. Karrow. Journal of Great Lakes Research JGLRDE, Vol. 12, No. 2, p 132-135, 1986. 2 fig, 8 ref.

Descriptors: *Shorelines, *Lake Algonquin, *Pa-leohydrology, *Paleolimnology, *Glacial lakes, *Geologic erosion, *Geological terraces. Lake Huron, Great Lakes, Topography, Terraces, On-

Recent shore erosion along the cliffed east side of Lake Huron in southwestern Ontario has left hanging valley terraces graded to former glacial and/or post-glacial lakes of the Huron basin. Plane table profiles along the valleys revealed terrace gradients of 5 to 7 meters per km. Elevations of the truncated ends of the terraces determined from surveyed profiles were supplemented by single point elevations in additional valleys. Extrapolation of the terrace gradients westward from these points to the published glacial Lake Algonquin itted shoreline allowed the former position of the Algonquin shoreline to be estimated. The Lake Algonquin shoreline apparently was located about one km west of the present shoreline but it was more irregular, no doubt being less mature in its development. Indentations in the former shoreline are indicated south of Bayfield, near the Lucknow River, and near Eighteen Mile River. (Author's abstract)

TIDE-INDUCED LAGRANGIAN RESIDUAL CURRENT AND RESIDUAL TRANSPORT: 1. LAGRANGIAN RESIDUAL CURRENT, Shandong Coll. of Oceanology (China). For primary bibliographic entry see Field 2L. W87-04752

TIDE-INDUCED LAGRANGIAN RESIDUAL CURRENT AND RESIDUAL TRANSPORT: 2. RESIDUAL TRANSPORT WITH APPLICATION IN SOUTH SAN FRANCISCO BAY, CALIFORNIA, Shandong Coll. of Oceanology (China). For primary bibliographic entry see Field 2L. W87-04753

KINETICS OF ION EXCHANGE ON NATURAL SEDIMENTS, California Univ., Davis. Dept. of Chemical Engi-

neering. A. P. Jackman, and K. T. Ng. Water Resources Research WRERAQ, Vol. 22, No. 12, p 1664-1674, November 1986. 6 fig, 9 tab, 33 ref. NSF Grant INT-8413879.

Descriptors: *Tracers, *Path of pollutants, *Sediments, *Ion exchange, *Ions, *Mathematical models, *Kinetics, Calcium, Streams, Diffusion, Particle size, Adsorption, Strontium.

Particle size, Adsorption, Strontium.

The influences of external film diffusion and internal pore diffusion in controlling the kinetics of ion-exchange adsorption on natural streambed sediments were investigated. Natural sediments were segregated by size into six groups ranging from 0.25-0.50 to 6.3-9.5 mm. Sized sediments were first saturated with calcium ions and then immersed in a reservoir containing a dilute solution of strontium ions under flow conditions similar to those encountered near the surface of a streambed. Reservoir concentration was determined as a function of time until a steady state was achieved. For the smallest sized particles, the strontium ion concentration versus time can be adequately described by a model that assumes that film diffusion controls the adsorption rate. For the largest sized particles, a model that assumes that internal diffusion controls the adsorption rate is adequate. For intermediate sizes, the influence of both film diffusion and internal diffusion must be accounted for to adequately describe the data. A criterion is proposed that can predict whether the adsorption process can be adequately described by the simpler film-diffusion-limiting or internal-diffusion-limiting models or

must be described by a model accounting for both processes. Effective diffusivities in the natural sediments were high due to a large contribution from surface diffusivities ranging from 3.6 x 10 to the minus 8th power to 15.9 x 10 to the minus 8th power accelerated. (Author's abstract)

ENVIRONMENTAL IMPACT OF THE SANMEN GORGE PROJECT, Scientific and Technological Information Inst., Beijing (China). Por primary bibliographic entry see Field 6G. W87-04774

CHEMICAL CONTROLS ON ECOLOGY IN A COASTAL WETLAND, Pennsylvania State Univ., University Park. Dept. of Geosciences. For primary bibliographic entry see Field 2L. W87-04822

POLYCYCLIC AROMATIC HYDROCARBONS IN SURFACE SEDIMENTS FROM THE ELIZA-BETH RIVER SUBESTUARY, William and Mary Coll, Gloucester Point, VA. Inst. of Marine Science. For primary bibliographic entry see Field 5A. W87-04885

HEAVY METALS DISTRIBUTION IN THE MOUTH OF THE BESOS AND LLOBREGAT RIVERS (DISTRIBUCION DE METALES PESADOS EN LAS DESEMBOCADURAS DE LOS RIOS BESOS Y LLOBREGAT (MEDITER-RANEO OCCIDENTAL),
Instituto de Investigaciones Pesqueras de Barcelona (Spain).

For primary bibliographic entry see Field 5B. W87-04914

SOIL STRENGTH, SLOPE, AND RAINFALL INTENSITY EFFECTS ON INTERRILL ERO-Iowa State Univ., Ames. Dept. of Agricultural Engineering.
D. A. Watson, and J. M. Laflen.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 98-102, January-February 1986. 4 fig, 6 tab, 20 ref.

Descriptors: "Soil erosion, "Soil strength, "Slope, "Rainfall intensity, "Interrill erosion, "Mathematical equations, "Erosion, "Rainfall simulators, Rainfall, Shear tests, Prediction, Estimating equations,

Erodibility.

State-of-the-art techniques for estimating soil erosion are moving from the statistically derived Universal Soil Loss Equation (USLE) for predicting long-term average soil loss to more fundamental, physically based models sequier information to characterize the physical processes of erosion. Although some of this information is available, much more refinement of relationships and determination of parameter values are needed. A small interrill rainfall simulator was used to evaluate the effects of rainfall interestry, soil strength and slope on interrill erosion. There was no interaction effect of slope on the exponent of the intensity term in an expression relating interrill detachment to rainfall intensity. Interrill soil erosion was well estimated by a prediction equation was well estimated by a prediction equation that included rainfall intensity, slope and soil shear strength (Alexander-PTT)

RUNOFF AND EROSIVE STORM OCCUR-RENCE PROBABILITIES, Rhode Island Univ., Kingston. Dept. of Natural Resources Science.
For primary bibliographic entry see Field 5G.

Group 2J-Erosion and Sedimentation

W87-04922

CONCENTRATED FLOW EROSION ON CON-VENTIONAL AND CONSERVATION TILLED WATERSHEDS,

WALEMSHEEDS, Agricultural Research Service, Council Bluffs, IA. R. G. Spomer, and A. T. Hjelmfelt. Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 124-127, 134, January-February 1986. 2 fig, 4 tab, 9 ref.

Descriptors: *Agricultural runoff, *Soil erosion, *Concentrated flow, *Erosion, *Runoff, *Tillage patterns, *Watersheds, *Sediment yield, Seed beds, Planting management, Storms, Soil conservation.

Planting management, Storms, Soil conservation.

Present methods for predicting soil erosion do not account for all the erosion that occurs on cropland. The Universal Soil Loss Equation (USLE) combines soil loss from interrill and rill erosion. Not included in USLE predictions is the soil eroded from concentrated flow channels, also referred to as ephemeral gully erosion. Concentrated flow (ephemeral) erosion channels were measured on a conventional and a conservation titlled watershed had 45 concentrated flow datershed had 45 concentrated flow erosion channels or 0.3 channels/a), while the conservation titlled watershed had 14 concentrated flow erosion channels or 0.3 channels/ha (0.1 channels/a). Erosion per channel from the conventional and conservation titlled watershed averaged 9 and 5 Mg (10 and 5.5 t), respectively. In 1985, erosion per unit of channel length on the conventionally titled watershed was determined to be 74.5 kg/m (50 lb/h). The estimated concentrated flow erosion for the conventionally tilled watershed was 17 Mg/ha (7.6 t/a) and 6.8 Mg/ha (3.0 t/a) in 1984 and 1985. Concentrated flow erosion for the conventionally tilled watershed was 17 Mg/ha (7.6 t/a) and 9.85. Concentrated flow erosion for the conventionally tilled watershed was 184 and 1985. Concentrated flow erosion was compared to sediment yields of 49 Mg/ha (22 t/a) and 3.4 Mg/ha (1.5 t/a) in 1984 and 1985. Concentrated flow erosion and planting. Thus, the importance of concentrated flow erosion was demonstrated on a storm period (Msy-June 1984) basis and a single event in 1985. (Alexander-PTT)

RUNOFF AND EROSION AS AFFECTED BY CORN RESIDUE: PART I. TOTAL LOSSES, Nebraska Univ.-Lincoln.

For primary bibliographic entry see Field 4D. W87-04926

RUNOFF AND EROSION AS AFFECTED BY CORN RESIDUE: PART II, RILL AND INTER-RILL COMPONENTS,

Nebraska Univ.-Lincoln.
For primary bibliographic entry see Field 4D.
W87-04927

CHEMICAL AND PHYSICAL ENRICHMENTS OF SEDIMENT FROM CROPLAND, Agricultural Research Service, Morris, MN. For primary bibliographic entry see Field 5B.

UNSTEADY SEDIMENT-TRANSPORT MOD-California Inst. of Tech., Pasadena. Dept. of Envi-

ronmental Health Engineering.
For primary bibliographic entry see Field 8B.
W87-05020

STABILITY OF A GENERAL PREISSMANN

SCHEME,
California Inst. of Tech., Pasadena. Dept. of Environmental Health Engineering.
D. A. Lyn, and P. Goodwin.
Journal of Hydraulic Engineering (ASCE)
JHEND8, Vol. 113, No. 1, p 16-28, January 1987.
5 fig. 13 ref, append. NSF Grant CEE79-20311
A02.

Descriptors: *Mathematical models, *Model studies, *Preissmann scheme, *Flow models, *Sediment transport, *Channel flow, *Flood routing, Sediments, Channels, Flow, Flood.

The stability and convergence characteristics of a four-point implicit finite-difference scheme due to Preissmann, which has been widely used in open-channel flow modeling, are examined. The analysis is made for a general linear hyperbolic system of n first-order equations, but is restricted to the homogeneous or frictionless case. The effect of a weighting factor in space, as well as in time, is considered. The specific case of unsteady sediment-transport modeling, which conventionally results in a third-order avstern, is discussed with particular reference order system, is discussed with particular reference to its singularly perturbed nature. Recommenda-tions for practical computations are made. (See also W87-05020) (Alexander-PTT)

MODELING SEDIMENT-INDUCED DENSITY CURRENTS IN SEDIMENTATION BASINS, CURRENTS IN SEDIMENTATION BASINS, Southern Illinois Univ. at Carbondale. Dept. of Engineering Mechanics and Materials. Por primary bibliographic entry see Field 5D. W87-05025

ANALYSIS OF BED-LOAD MOTION AT HIGH

SHEAR STRESS,
Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering. For primary bibliographic entry see Field 8B. W87-05026

EFFECT OF MISSISSIPPI RIVER DELTA LOBE DEVELOPMENT ON THE HABITAT COMPOSITION AND DIVERSITY OF LOUISI-ANA COASTAL WETLANDS, Louisiana State Univ., Baton Rouge. Coastal Ecol-

Louisana State Univ., naton Rouge. Coastal Ecology Lab.
C. Neill, and L. A. Deegan.
The American Midland Naturalist AMNAAF,
Vol. 116, No. 2, p 296-303, October 1986. 4 fig. 1
tab, 8 ref. Fish and Wildlife Service Contract 14tab, 8 res. riss 16-009-80-073.

Descriptors: *Deltas, *Habitats, *Mississippi River, *Coastal waters, *Wetlands, *Louisiana, *Sedimentation, *Erosion, Salt marshes, River diversion, Rivers, Sediments, Mudflats, Deposition.

sion, Rivers, Sediments, Mudflats, Deposition.

Land in the Mississippi River delta region was formed during the last 6000 years by sediment deposited in major deltaic lobes by the Mississippi River. Together the delta lobes built a broad plain of approximately 3 million ha. The nature and timing of these deltaic deposits control the long-term dynamics and persistence of the habitats found in this predominantly wetland coastal region. The five delta lobes that today make up the Mississippi River deltaic plain range in age from 10-4000 years. New delta lobes begin to form approximately once every 1000 years in response to a major change in the course of the river. The patterns of habitat changes that occur during the growth and decay of Mississippi River deltaic lobes using habitat maps constructed from aerial photographs. Mudflats and fresh marshes dominated young delta lobes (10-1000 years old). Intermediate-aged lobes (1000-2000 years old) intermediate-aged lobes (1000-2000 years old) contained large areas of salt and brackish marshes and open water. The number of habitat diversity (H) were lowest in the youngest lobe (N = 56, H² = 1.79), and intermediate in the oldest lobe (N = 56, H² = 1.77), and intermediate in the oldest lobe (N = 44, H² = 1.38). A new cycle of vegetation change is initiated approximately every 1000 years when upstream river diversion reintroduces fresh water and sediment into an old lobe. (Alexander-PTT)

METAL ASSOCIATIONS IN ANOXIC SEDI-MENTS AND CHANGES FOLLOWING UPLAND DISPOSAL, Technische Univ. Hamburg-Harburg (Germany,

For primary bibliographic entry see Field 5E. W87-05035

2K. Chemical Processes

ANION EXCLUSION DURING TRANSPORT THROUGH THE UNSATURATED ZONE,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2G.
W87-04399

CALCITE PRECIPITATION IN LAKE CON-STANCE: CHEMICAL EQUILIBRIUM, SEDI-MENTATION, AND NUCLEATION BY ALGAE, Konstanz Univ. (Germany, F.R.). Limnological For primary bibliographic entry see Field 2H. W87-04432

FORMATION OF METHANE AND CARBON DIOXIDE FROM DIMETHYLSELENIDE IN ANOXIC SEDIMENTS AND BY A METHANO-GENIC BACTERIUM, Geological Survey, Menlo Park, CA. Water Resources Div. For primary bibliographic entry see Field 5B. W87-04460

METABOLISM OF REDUCED METHYLATED SULFUR COMPOUNDS IN ANAEROBIC SEDI-MENTS AND BY A PURE CULTURE OF AN ESTUARINE METHANOGEN,

State Univ. of New York at Stony Brook. Marine Sciences Research Center. For primary bibliographic entry see Field 2L. W87-04461

MANGANESE OXIDATION BY SPORES AND SPORE COATS OF A MARINE BACILLUS SPECIES.

SFECIES, Leiden Rijksuniversiteit (Netherlands). J. P. M. deVrind, E. W. deVrind-deJong, J.-W. H. deVoogt, P. Westbroek, and F. C. Boogerd. Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 5, p 1096-1100, November 1986. 6 fig, 21 ref.

Descriptors: *Oxidation, *Manganese, *Spores, *Marine bacteria, *Metabolism, *Sediments, Inhibition, Anaerobic conditions, Adsorption, Oxygen, *Bacteria, Heavy metals, Accumulation, Ions.

Bacteria, Heavy metals, Accumulation, Ions. A wide variety of different bacteria have the ability to catalyze the reduction or oxidation of manganese. The question arises whether these manganese transformations may be involved in the primary metabolism of bacterial cells. Chemolithotrophic or mixotrophic growth sustained by Mn(2+) ions has been suggested for several manganese-oxidizing bacterial strains. However, so far no unambiguous evidence to support this idea has been presented. Bacillus sp. strain SG-1 is a marine bacterial species isolated from a near-shore manganese ediment sample. Its mature dormant spores promote the oxidation of Mn(2+) to MnO2. By quantifying the amounts of immobilized and oxidized manganese, it was established that bound manganese was almost instantaneously oxidized. When the final oxidation of manganese by the spores was partly inhibited by NaN3 or anaerobiosis, an equivalent decrease in manganese immobilization was observed. After formation of a certain amount of MnO2 by the spores, the oxidation rate decreased. A maximal encrustment was observed after which no further oxidation occurred. The oxidizing activity could be recovered by reduction of the MnO2 with hydroxylamine. Once the stores were encreased. ity could be recovered by reduction of the MnO2 with hydroxylamine. Once the spores were encrusted, they could bind significant amounts of manganese, even when no oxidation occurred. Pumanganese, even when no oxidation occurred. Purified spore coat preparations oxidized manganese at the same rate as intact spores. During the oxidation of manganese in spore coat preparations, molecular oxygen was consumed and protons were liberated. The data indicate that a spore coat component promoted the oxidation of Mn(2+) in a biologically catalyzed process, after adsorption of

Chemical Processes—Group 2K

the ion to incipiently formed MnO2. Eventually, when large amounts of MnO2 were allowed to accumulate, the active sites were masked and further oxidation was prevented. (Alexander-PTT)

MICROBIAL IRON REDUCTION BY ENRICH-MENT CULTURES ISOLATED FROM ESTUA-RINE SEDIMENTS, New Hampshire Univ., Durham. Jackson Estua-rine Lab.

For primary bibliographic entry see Field 2H. W87-04463

STIMULATION OF BACTERIAL DNA SYN-THESIS BY ALGAL EXUDATES IN AT-TACHED ALGAL-BACTERIAL CONSORTIA, For primary bibliographic entry see Field 2H. W87-04464

GEOCHEMICAL CHARACTERIZATION OF SUSPENDED PARTICLES IN ESTUARINE AND COASTAL SEAWATER BY X-RAY FLUORESCENCE SPECTROMETRY, Tokyo Univ. (Japan). Dept. of Chemistry. For primary bibliographic entry see Field 2L. W87-04467

QUIESCENT CONSOLIDATION OF PHOS-PHATIC WASTE CLAYS, Florida Univ., Gainesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W87-04468

CONTRIBUTION TO THE STUDY OF TEMPO-RAL VARIATIONS IN THE CHEMISTRY OF SPRING WATER IN KARSTIFIED CARBON-Agriculture and Water Resources Research Centre, Baghdad (Irag). Por primary bibliographic entry see Field 2F. W87-04563

UPLAND AFFORESTATION: INFLUENCES ON STREAM HYDROLOGY AND CHEMIS-TRY,
Institute of Terrestrial Ecology, Bangor (Wales).
Bangor Research Station.
For primary bibliographic entry see Field 4C.
W87-04574

NITRATE LEACHING FROM A SMALL, UN-DERDRAINED, GRASSLAND, CLAY CATCH-MENT, Oxford Univ. (England). Soil Science Lab. For primary bibliographic entry see Field 5B. W87-04579.

UO2(2+)-HUMATE INTERACTIONS IN SOFT, ACID, HUMATE-RICH WATERS, Michigan State Univ., East Lansing. Dept. of Fish-eries and Wildlife. For primary bibliographic entry see Field 5B. W87-04580

COURDINATIVE INTERACTIONS BETWEEN SOIL SOLIDS AND WATER - AN AQUATIC CHEMIST'S POINT OF VIEW, Ecole Plytechnique Federale de Lausanne (Switzerland). Inst. for Resources and Water Pollution Control. W. Stum

Geoderma GEDMAB, Vol. 38, No. 1-4, p 19-30, September 1986. 7 fig, 1 tab, 29 ref.

Descriptors: "Soil chemistry, "Water chemistry, "Soil solids, "Oxides, "Ligand complexes, "Rate laws, "Metals, "Mineral precipitation, Surface pronation, Minerals, Mineral phase dissolution, Rocka, Rock weathering, Sediments, Metal corro-

Almost all the problems associated with understanding the rate processes that control the composition of our environment concern interfaces. Oxides, especially those of Si, Al, Fe, and Mn are abundant in the earth's crust. The oxygen donor atoms present on the hydrous oxide surfaces tend to undergo protolysis and to form complexes with metal ions, and to become exchanged for other ligands (anions or weak acids). Many of these surface complexes are of an inner-sphere nature. The rates of processes occurring at the hydrous oxide surfaces, such as precipitation (heterogeneous nucleation on oxide surfaces) of minerals and dissolution of mineral phases which are of importance in the weathering of rocks, in the formation of soils and sediments, in the corrosion of metals and their inhibition, are critically dependent on the coordinative interactions taking place on these surfaces. Rate laws showing dependence on the concentration of surface ligand complexes and on surface protonation were derived. (Author's abstract) W87-04584

MULTISPECIES CATION LEACHING DURING CONTINUOUS DISPLACEMENT OF ELECTROLYTE SOLUTIONS THROUGH SOIL COLUMNS,
Florida Univ., Gainesville. Dept. of Soil Science. For primary bibliographic entry see Field 5B. W87-04586

MODEL OF ION TRANSPORT THROUGH A FORESTED CATCHMENT AT LANGE BRAMKE, WEST GERMANY, Goettingen Univ. (Germany, F.R.). Abt. Bodenkunde und Waldernahrung. For primary bibliographic entry see Field 5B. W87-04588

TRANSIENT MASS-TRANSPORT IN THE PRESENCE OF NON-LINEAR PHYSICO-CHEMICAL INTERACTION LAWS: PROGRESSIVE MODELLING AND APPROPRIATE EXPERIMENTAL PROCEDURES,

Centre National de la Recherche Scientifique, Nancy (France). Lab. des Sciences du Genie Che-For primary bibliographic entry see Field 5B. W87-04589

EVIDENCES FOR THE EXISTENCE OF A RETENTION PHENOMENON DURING THE MIGRATION OF A MERCURIAL SOLUTION THROUGH A SATURATED POROUS Strasbourg-1 Univ. (France). Inst. de Mechanique des Fluides.

For primary bibliographic entry see Field 5B. W87-04593

CHEMICAL TRANSPORT UNDER NO-TILL FIELD CONDITIONS, Science and Education Administration, Beltsville, MD.

For primary bibliographic entry see Field 5B. W87-04596

MULTICOMPONENT TRANSPORT MODEL, Goettingen Univ. (Germany, F.R.). Abt. Boden-kunde und Waldernahrung. For primary bibliographic entry see Field 5B. W87-04597

EXPECTED SPECIATION OF DISSOLVED TRACE METALS IN GRAVITATIONAL WATER OF ACID SOIL PROFILES, Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Genie Rural. For primary bibliographic entry see Field 5B. W87-04598

SORPTION KINETICS AND TRANSPORT OF PHOSPHATE IN SANDY SOIL,
Agricultural Univ., Wageningen (Netherlands).
Dept. of Soil Science and Geology.

For primary bibliographic entry see Field 5B. W87-04599

NITROGEN CYCLE OF AN EAST COAST, U.K. SALTMARSH: II. NITROGEN FIXATION, NITRIFICATION, DENITRIFICATION, TIDAL Essex Univ., Colchester (England). Dept. of Biol-

For primary bibliographic entry see Field 2L. W87-04604

PURIFICATION OF PCB CONTAMINATED WATER BY CHITOSAN: A BIOLOGICAL TEST OF EFFICIENCY USING THE COMMON BARBEL, BARBUS BARBUS, Liege Univ. (Belgium). Lab. of Animal Morpholo-

gy. For primary bibliographic entry see Field 5D. W87-04666

KINETICS OF HYDROGEN PEROXIDE-SULFURIV) REACTION IN RAINWATER COLLECTED AT A NORTHEASTERN U.S.

Brookhaven National Lab., Upton, NY. Environmental Chemistry Div.
For primary bibliographic entry see Field 2B.
W87-04674

RATE OF PRECIPITATION SCAVENGING OF NITRATES ON CENTRAL LONG ISLAND, State Univ. of New York at Stony Brook. Dept. of Mechanical Engineering. For primary bibliographic entry see Field 5B. W87-04678

TRANSPORT OF OZONE BETWEEN BOUND-ARY LAYER AND CLOUD LAYER BY CUMU-LUS CLOUDS,

National Oceanic and Atmospheric Administra-tion, Boulder, CO. Environmental Sciences Group. For primary bibliographic entry see Field 2B. W87-04679

CHEMISTRY OF OH IN REMOTE CLOUDS AND ITS ROLE IN THE PRODUCTION OF FORMIC ACID AND PEROXYMONOSUL-

FORMIC ACID AND PEROXIMONOSCI-FATE, Harvard Univ., Cambridge, MA. Center for Earth and Planetary Physics. For primary bibliographic entry see Field 5B. W87-04682

SPECIATION, PHOTOSENSITIVITY, AND REACTIONS OF TRANSITION METAL IONS IN ATMOSPHERIC DROPLETS, Bell Communications Research, Inc., Holmdel, NJ. For primary bibliographic entry see Field 2B. W87-04686

CONDITIONS FOR MINIMUM ADSORPTION OF ZINC ON CONTAINER SURFACES, Al-Najah Univ., Nablus (Israel). For primary bibliographic entry see Field 5A. W87-04689

MANGANESE BIOGEOCHEMISTRY IN SMALL ADIRONDACK FORESTED LAKE WA-TERSHED. Geological Survey, Doraville, GA. Water Resources Div. For primary bibliographic entry see Field 5B. W87-04754

KINETICS OF ION EXCHANGE ON NATURAL SEDIMENTS, California Univ., Davis. Dept. of Chemical Engiary bibliographic entry see Field 2J.

For primar W87-04756

Field 2—WATER CYCLE

Group 2K—Chemical Processes

DEGRADATION OF SPARTINA LIGNOCEL-LULOSE BY INDIVIDUAL AND MIXED CUL-TURES OF SALT-MARSH FUNGI, George Mason Univ., Fairfax, VA. Dept. of Biol-

ogy. For primary bibliographic entry see Field 5C. W87-04819

INTERACTION OF CERTAIN HEAVY METALS WITH LAKE HUMIC ACIDS, Kashmir Univ., Srinagar (India). Centre of Re-search for Development. Por primary bibliographic entry see Field 5B. W37-04884

KINETICS OF FORMALDEHYDE-S(IV) ADDUCT FORMATION IN SLIGHTLY ACIDIC

SOLUTION,
California Inst. of Tech., Pasadena. W.M. Keck
Lab. of Environmental Engineering Science.
For primary bibliographic entry see Field 5B.
W87-04994

ECOLOGICAL INTERPRETATION OF THE CHEMISTRY OF MIRE WATERS FROM SE-LECTED SITES IN EASTERN CANADA,

Durham Univ. (England). Dept. of Botany. P. L. Comeau, and D. J. Bellamy. Canadian Journal of Botany CJBOAW, Vol. 64, No. 11, p 2576-2581, November 1986. 3 fig. 4 tab,

Descriptors: "Water chemistry, "Mire water, "Water analysis, "Water sampling, "Chemical anal-ysis, Comparison studies, Canada, Mires, Coastal waters, Ions, Nutrients, Europe.

Water samples (132) were collected from selected mires in eastern Canada. Sites chosen included ombrotrophic, transition, and minerotrophic mire in both maritime and continental areas in Nova Scotia, New Brunswick, and Quebec. Chemical analysis of the major ions found in mire waters revealed that concentrations increased from ombrotrophic to minerotrophic conditions. Chloride, sodium, and magnesium were more abundant in maritime mires, while calcium, potassium, and sulfate had higher levels in transition and ombrotrophic mire in agricultural areas. Comparison with phic mire in agricultural areas. Comparison with studies in Europe indicates similar ionic conditions for the three mire categories with respect to prox-imity to the sea and human disturbance. (Author's abstract) W87-05061

GENERATION OF GROUND-WATER AGE

Nevada Univ. System, Reno. Water Resources Center. ary bibliographic entry see Field 2F.

GEOCHEMICAL EVOLUTION OF WATERS AND SOIL SOLUTION DURING THEIR CON-AND SOIL SOLUTION DURING THEIR CON-CENTRATION IN CENTRAL TUNISIA (EYO-LUTION GEOCHIMIQUE DES EAUX ET DES SOLUTIONS INTERSTITIELLES AU COURS DE LEUR CONCENTRATION EN TUNISIE CENTRALE), Centre de Recherche du Genie Rural, Tunis (Tuni

aia). A. Bahri, S. Amami, and T. Gallali.
IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 197-208, 6 fig, 2 tab, 9 ref.

Descriptors: *Geochemistry, *Soil water, *Surface water, *Tunisia, Equilibrium, Irrigation water, Streams, Alkalinity, Groundwater, Chemical prop-

A geochemical study of the river system in central Tunisis was carried out on the basis of equilibrium relations between minerals and aqueous solutions in order to explain the soil solution species and the

nature of soil solution chemical mechanisms that govern the pedological evolution of the irrigated soils. It is shown that there is a relationship besoils. It is shown that there is a relationship between stream waters, underground waters and soil solution, which exists as a function of the concentration factor. This relationship is confirmed by the determination of the generalized residual alkalinity. During the concentration of the solutions the evolution of the chemical changes is not proportional to the concentration because of the precipitations that occur. This geochemical pathway study will help to check and reduce soil damage risks. (See also W87-05110) (Author's abstract)

GEOCHEMICAL PARAMETERS AS INDICATORS FOR GROUNDWATER FLOW, Waterloo Univ. (Ontario). Dept. of Earth Sciences. For primary bibliographic entry see Field 2F. W87-05121

2L. Estuaries

NITROGEN FIXATION (C2H2 REDUCTION) IN A SALT MARSH: ITS RELATIONSHIP TO TEMPERATURE AND AN EVALUATION OF AN IN SITU CHAMBER TECHNIQUE, South Carolina Univ., Columbia Belle W. Baruch Inst. for Marine Biology and Coastal Research. G. J. Whiting, and J. T. Morris. Soil Biology and Biochemistry SBIOAH, Vol. 18, No. 5, p 515-521, 1986. 7 fig, 22 ref.

Descriptors: *Nitrogen fixation, *Salt marshes, *Nitrification, *Acetylene reduction, Cordgrass, Bacterial physiology, Soil bacteria, Incubation, Seasonal variation, Sediments.

A temperature-controlled chamber for the in situ A temperature-controlled chamber for the in situ measurement of N fixation in a vegetated salt marsh is described. Rates of Acetylene Reduction Activity (ARA) were linear during a 9 hr incubation. The chamber technique measures ARA within the top 2.4 cm of the sediment column. This death of penetration accounted for approximately. depth of penetration accounted for approximately 60% of the total ARA in the sediment column. Measurements of in situ ARA in the tall, medium, Measurements of in situ ARA in the sediment column, and short Spartina alterniflora salt marshes were positively correlated with seasonal temperature variations. About 70-80% of the seasonal variation in ARA was explained by the Arrhenius relationship, as follows: ARA (micromole C2H4/sq m/hr) = alpha raised to the (minus beta/T) power, where T is the ambient air temperature (C) and alpha and beta are constants. Alpha in this model increased from 20.1 to 40.5, while beta increased from 17.5 to 20.7, along a transect from the tall to short S alterniflora communities. These differences suggest that there is spatial variability within the salt marsh among the variables that affect N fixation. (Author's abstract) W87-04366

OBSERVATIONS ON THE POPULATION DYNAMICS AND DISTRIBUTION OF THE
WHITE PRAWN PALAEMON LONGIROSTRIS
H. MILNE EDWARDS, 1837 (CRUSTACEA, DECAPODA, NATANTIA) IN THE NETHERLANDS, WITH SPECIAL REFERENCE TO ITS
OCCURRENCE IN THE MAJOR RIVERS,
VORBIECH USEN THE MAJOR RIVERS,
VORBIECH USEN THE MAJOR RIVERS, Katholieke Univ. Nijmegen (Netherlands). Lab. of

Aquatic Ecology.

Aquatic Ecology.

For primary bibliographic entry see Field 2H.

W87-04408

INFLUENCE OF SALINITY ON THE DISTRI-BUTION OF EGERIA DENSA IN THE VALDI-VIA RIVER BASIN, CHILE,

Pontificia Univ. Catolica de Chile, Temuco. E. Hauenstein, and C. Ramirez. Archiv fuer Hydrobiologie AHYBA4, Vol. 107, No. 4, p 511-519, October 1986. 5 fig, 3 tab, 15 ref.

Descriptors: *Water pollution effects, *Salinity, *Plant growth, *Valdivia river basin, Biomass, Saline water, Photosynthesis, Roots, Chile, River

The influence of salinity on the distribution of Egeria densa in the Valdivia river basin was made. Measurements were taken of the biomass of this Measurements were taken or the biomass or this species from locations of differing salinity within the range of its distribution in the Valdivia river. In the laboratory, the growth and photosynthetic rates of shoots kept in different saline concentrations were recorded. It was found that Egeria densa tolerated salinities up to 5 g/l, which grow naturally in the river. In the laboratory, by contest it prospected in concentrations up to ground 8 trast, it prospered in concentrations up to around 8 g/l. In concentrations up to around 1 g/l there was a clear stimulation of shoot growth; in greater concentrations a slight inhibition of photosynthesis, growth and adventitious root production was noted. (Author's abstract) W87-04410

NUTRIENT LIMITATION OF THE BOTTOM-ICE MICROALGAL BIOMASS (SOUTHEAST-ERN HUDSON BAY, CANADIAN ARCTIC), Centre de Recherche en Ecologie Marine et Aqua-culture, Nieul sur Mer (France). For primary bibliographic entry see Field 2C. W87-04426

METABOLISM OF REDUCED METHYLATED SULFUR COMPOUNDS IN ANAEROBIC SEDI-MENTS AND BY A PURE CULTURE OF AN ESTUARINE METHANOGEN,

State Univ. of New York at Stony Brook. Marine Sciences Research Center.

R. P. Kiene, R. S. Oremland, A. Catena, L. G. Miller, and D. G. Capone.
Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 5, p 1037-1045, November 1986. 5 fig. 3 tab, 31 ref. NSF Grants OCE-84-17595, OCE-85-16604.

Descriptors: *Metabolism, *Biodegradation, *Sulfur compounds, *Anaerobic sediments, *Cul-tures, *Estuaries, *Methane bacteria, Sulfides, Sediments, Bacteria, Growth, Inhibition, Sub-

Methylated reduced sulfur compounds are thought to play an important role in the transfer of sulfur from aquatic and terrestrial ecosystems to the atmosphere. However, microbial decomposition of these volatile compounds may decrease their outward flux. Addition of dimethylsulfide(DMS), or methane thiol(MSH) to a diversity of anoxic aquatic sediments (e.g., fresh water, estuarine, alkaline/hypersaline) stimulated methane production. The yield of methane recovered from DMS was often 52 to 63%, although high concentrations of DMS (as well as MSH and DMDS) inhibited methanogemess in some types of sediments. Production of meth-63%, although high concentrations of DMS (as well as MSH and DMDS) inhibited methanogenesis in some types of sediments. Production of methane from these reduced methylated sulfur compounds was blocked by 2-bromoethanesulfonic acid. Sulfate did not influence the metabolism of millimolar levels of DMS, DMDS, or MSH added to sediments. However, when DMS was added at 2-microM levels as (14C)DMS, metabolism by sediments resulted in a 14CH4/14CO2 ratio of only 0.06. Addition of molybdate increased the ratio to 1.8, while 2-bromoethanesulfonic acid decreased it to 0, but did not block 14CO2 production. These results indicate the methanogens and sulfate reducers compete for DMS when it is present at low concentrations; however, at high concentrations, DMS is a 'noncompetitive' substrate for methanogens. Metabolism of DMS by sediments resulted in the appearance of MSH as a transient intermediate. A pure culture of an obligately methylotrophic estuarine methanogen was isolated which was capable of growth on DMS. Metabolism of DMS by the culture also resulted in the transient appearance of MSH, but the organism could grow on neither MSH nor DMDS. The culture metabolized (14C)-DMS to yield a 14CH4/4CO2 ratio of 2.8. Reduced methylated sulfur compounds represent a new class of substrates for methanogens and may be potential precursors of methane in a variety of aquatic habitats. (Alexan-der-PTT) der-PTT)

Estuaries—Group 2L

MANGANESE OXIDATION BY SPORES AND SPORE COATS OF A MARINE BACILLUS SPECIES, Leiden Rijk

Leiden Rijksuniversiteit (Netherlands). For primary bibliographic entry see Field 2K. W87-04462

MICROBIAL IRON REDUCTION BY ENRICH-MENT CULTURES ISOLATED FROM ESTUA-RINE SEDIMENTS

New Hampshire Univ., Durham. Jackson Estua-For primary bibliographic entry see Field 2H. W87-04463

GEOCHEMICAL CHARACTERIZATION OF SUSPENDED PARTICLES IN ESTUARINE AND COASTAL SEAWATER BY X-RAY FLUO-RESCENCE SPECTROMETRY, Tokyo Univ. (Japan). Dept. of Chemistry. T. Akagi, and H. Haraguchi. Chemistry Letters CMLTAG, No. 7, p 1141-1144, July 1986. 3 fig. 11 ref.

Descriptors: *Geochemistry, *Suspended solids, *Chemical analysis, *Seawater, *Estuaries, *Coasts, *X-ray fluorescence, *Spectrometry, *Water analysis, Fluorescence, Aluminum, Iron, Titanium, Heavy metals, Silicon, Calcium, Potassi-um, Copper, Zinc, Spectral analysis.

um, Copper, Zinc, Spectral analysis.

The elemental compositions of suspended particles collected in Tokyo Bay and Tamagawa River Estuary were determined by x-ray fluorescence spectrometry. Concentrations of Al, Ti, and Fe in suspended particles were found to decrease more rapidly than those of Si, Ca, K, Cu, and Zn from the estuarine to the bay areas. It is concluded that Tamagawa River water carries silicate minerals (rich in Si, K, and Ca) and clay minerals (rich in Si, Al, Ti, and Fe). These minerals are deposited on the sea floor during flow into the bay. The clay minerals may be more rapidly deposited than the silicate minerals. Organic suspended particles, including microorganisms, become rich in the area where the river and sea waters are mixed. Mineralrich suspended particles carried by the river water are covered with organic materials such as humic acid during the flow near the estuary. It is suggested that biological activities should be taken into account in the elemental distributions of suspended particles as well as dissolved forms in the estuary. (Author's abstract)

PALMIET ESTUARY: A MODEL FOR WATER CIRCULATION USING SALINITY AND TEMPERATURE MEASUREMENTS OVER A TIDAL CYCLE,

TIDAL CYCLE, National Research Inst. for Oceanology, Stellenbosch (South Africa).
S. Taljaard, G. A. Eagle, and H. F.-K. O. Hennig. Water S. A. WASADV, Vol. 12, No. 3, p 119-126, July 1986. 10 fig, 1 tab, 30 ref.

Descriptors: *Tidal currents, *Water analysis, *Estuaries, *Mathematical models, *Tidal effects, *Tides, *Salinity, *Water temperature, *South Africa, *Palmiet Estuary, Chemical analysis, Humic acids, Sediment cores.

Salinity and temperature measurements were taken over a spring and a neap tidal cycle in mid-summer (February 1985) in the Palmiet Estuary, South Africa. To date no in-depth chemical investigations have been done on the 'black water' systems in the South Western Cape. Measurements were taken at 9 stations (5 in the water channel, 4 on sand flats). At each station salinity, temperature, and pH were measured. Additional water samples were obtained by boat for measurement of nutrients, particulate matter, dissolved O2 and pH. Sediment cores were obtained as well. A conceptual model was compiled from this data, which showed the estuary as having two distinct layers, a fresher surface water layer overlaying a saline bottom layer. The fresher surface layer flowed almost continuously seawards. During spring high tide, new saline water replaced the bottom water and the in-flow energy determined how far this new water protruded into

the estuary. During the subsequent neap tide the bottom water remained in the estuary, with a small amount of water exchanged at the shallower stations near the mouth. During each neap tidal cycle there was a net loss of bottom water which was replaced during the next spring high tide or by a storm at sea. (Airone-PTT)

SPATIAL AND SEASONAL DIFFERENCES IN THE FISH FAUNA IN THE SHALLOWS OF A LARGE AUSTRALIAN ESTUARY, Murdoch Univ. (Western Australia). School of Environmental and Life Science. N. R. Loneragan, I. C. Potter, R. C. J. Lenanton, and N. Caputi. Marine Biology MBIOAJ, Vol. 92, No. 4, p 575-586, September 1986. 5 fig, 6 tab, 36 ref.

Descriptors: *Fish, *Estuaries, *Spatial distribu-tion, *Season variation, *Australia, *Salinity, Rivers, Temperature effects.

Whether the number of fish species and the density and biomass of fish are related to salinity were tested. Samples of fish were collected by beach seine in the large Peel-Harvey estuarine system in the wet and dry periods between August 1979 and July 1981. The number of species, density and biomass declined with distance from the estuary mouth and rose with increasing temperature and salinity. Both classification and ordination distinguished the faunal composition of the saline reaches of the the rivers from that of the narrow Entrance Channel and two large basins. Classification wet- and dry-period components, and divided samples taken in the Entrance Channel from those in the basins. Differences between the faunal comsamples taken in the Entrance Channel from those in the basins. Differences between the faunal composition of the Peel Inlet and its tributary rivers were related to differences in salinity regime. The riverine fauna was subjected to much more variable and lower minimum salinities. (Main-PTT) W37-04540

PREDATION BY CALLINECTES SOPIDUS (RATHBUN) WITHIN SPARTINA ALTERNIFICORA (LOISEL) MARSHES, Dauphin Island Sea Lab., AL. D. L. West and, and A. H. Williams. Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 100, No. 1-3, p 75-95, September 1986. 9 fig, 5 tab, 26 ref.

Descriptors: *Predation, *Food habits, *Marsh grasses, *Blue crabs, *Alabama, Marshes, Snails, Bivalves, Field tests, Tidal marshes.

Predation by the blue crab, Callinectes sapidus, within intertidal Spartina alternifora marshes of Dauphin Island, Alabama was examined. Species and size preferences displayed by the predator when foraging within the marsh were investigated using nektonic, epifaunal, and infaunal prey populations including Fundulus similis, Littorina irrorata, and Geukensia demissa. Short-term field experiment involving the use of predator inclusion cages, in which the relative abundances of all preyspecies and the density of macrophyte vegatation were manipulated, indicated that mean mortality differed significantly among species. Blue crabs exhibited a species preference for Littorina, and Fundulus but not for Geukensia. Blue crabs select-dintermediate-sized snalis and large fish while not exhibiting a size preference for infaunal bivalves. In the marsh, mean percentage of the Littorina population within the 14-18 mm size class exhibited ibiting a size preference for infaunal bivalves, the marsh, mean percentage of the Littorina ulation within the 14-18 mm size class exhibited increased mystellive. population within the ¹4-18 mm size class exhibited an increased mortality as compared to two other size classes, which was negatively correlated with increasing tidal height. Geukensis size class distributions showed little evidence of differences along the tidal height gradient. It was apparent the Calinectes utilized prey species differentially. The preference of blue crabs for nektonic and epifaunal prey is hypothesized to be the result of a smaller energy expediture as a result of the crab's visual evaluation of these prey. (Main-PTT) W87-04543

PRODUCTION OF NH4(+) BY THE SHRIMP CRANGON CRANGON L, IN TWO SLOPING

BED ECOSYSTEMS, EXPERIMENTAL APPROACH AND STUDY OF THE INFLUENCE OF SEDIMENT ON THE EXCRETION RATE (PRODUCTION D'NH4+) PAR LA CREVETIE CRANGON CRANGON L. DANS DEUX ECOSYSTEMES COTIERS. APPROCHE EXPERIMENTALE ET ETUDE DE L'INFLUENCE DU SEDIMENT SUR LE TAUX D'EXCRETION), Centre d'Études d'Oceanographie et de Biologie Marine, Roscoff (France). For primary bibliographic entry see Field 2H. W87-04544

EFFECTS OF PREDATION BY THE MUMMICHOG, FUNDULUS HETEROCLITUS (L.), ON THE ABUNDANCE AND DISTRIBUTION OF THE SALT MARSH SNAIL, MELAMPUS BIDENTATUS (SAY), Delaware Univ., Newark. Dept. of Biology. A. A. Joyce, and S. B. Weisberg.
Journal of Experimental Marine Biology and Ecology JEMBAM, Vol. 100, No. 1-3, p 295-306, September 1986. 4 fig., 1 tab, 29 ref. NOAA Sea Grant NA80AA-D-00106.

Descriptors: *Population density, *Estuaries, *Pridation, *Mummichog, *Salt marshes, *Snai *Canary Creek, Killifish, Coastal waters, Grass

Enclosure and exclosure experiments were conducted in Canary Creek marsh to examine how predation by killifish, Fundulus heteroclitus, affects the abundance and size distribution of the although the conductive states and the conductive states are conducted with Fundulus at densities of one-self-conductive states are conducted with Fundulus at densities of one-self-conductive states are conducted as a self-conductive states and the conductive states are conducted as a self-conductive states and the conductive states are conducted as a self-conductive states and conductive states are conducted as a self-conductive state states are conducted as a self-conductive state states are conducted as a self-conductive state states are conducted as a self-conductive states are conducted as a self-conductive states are conducted as a self-conducted marsh snail, Melampus bidentatus. Enclosures were stocked with Fundulus at densities of one-half normal, normal, twice normal, and four times normal density. Fish exclusion pens were also built. In both years of the study, the mean density of snails increased significantly in pens where fish were excluded or their density reduced. During the same period in each year, the density of snails in pens containing higher than normal fish density fell by 50%. Fish density also affected the size distrubtion of snails within pens. In both years, mean shell length of snails within pens with the highest density of fish was significantly greater, and mean shell length of snails within fish exclusion pens was significantly lower than in all other treatments. Gape size limitation of Fundulus causes selective predation on small snails and apparently is responsible for the difference in mean shell length among treatments. Density and size distribution of the natural Melampus bidentatus population in the marsh were also taken. Larger snails occurred in the high marsh zone. The grass types found in the high marsh afford protection from fish predation, and the distribution of snails in the marsh is consistent with the idea that fish predation is an important factor influencing the distribution of snails in Canary Creek marsh. (Author's abstract) stract) W87-04546

ROCKY INTERTIDAL FISH COMMUNITIES OF CALIFORNIA: TEMPORAL AND SPATIAL VARIATION, California_Univ., Davis. Dept. of Wildlife and

Cantorina Only, Davis, Dept. of winnie and Fisheries Biology. R. M. Yoshiyama, C. Sassaman, and R. N. Lea. Environmental Biology of Fishes EBFID3, Vol. 17, No. 1, p 23-40, September 1986. 10 tab, 28 ref.

Descriptors: *Species composition, *Species diversity, *Spatial variation, *Temporal variation, *Fish, *California, *Oregon, *British Columbia, Cottids, Ecology, Pacific Sculpins, Tidepools, Zoogeography, Comparison studies.

Data from experimental and published collections of intertidal and shallow littoral fishes of the North American Pacific Coast with respect to temporal and spatial trends in species composition and dominance were examined. Sampling of tidepools usually was done by applying quinadline and dipnetting fish. Dipnetting alone was done in Oregon. Recent and past intertidal collections made five and severa years apart, respectively, for two California localities; intertidal collections from twelve localities in intertidal collections from twelve localities in the california, Oregon, and British Columbia; and intertidal versus subtidal collections at one California

Field 2-WATER CYCLE

Group 2L—Estuaries

locality were compared. Temporal comparisons indicted substantially lower abundance of the cottid Oligocottus snyderi at two California localities during 1984. Geographical comparisons indicted general similarity in species composition, with cottids predominating. Stichaeids and pholids occurred at high densities in exposed boulder fields. Both the tidepool and boulder field assemblages showed north-outh changes in species abundances. Comparison of collections from the intertidal and subtidal zones at one California locality demonstrated that fishes of the these habitats form two essentially distinct assemblages, with most species restricted to or concentrated in one or the other habitat. (Main-PTT)

FISH COMMUNITY STRUCTURE RESPONSE TO MAJOR HABITAT CHANGES WITHIN THE LITTORAL ZONE OF AN ESTUARINE

COASTAL LAKE, Rhodes Univ., Grahamstown (South Africa). Inst. of Freshwater Studies.

For primary bibliographic entry see Field 2H. W87-04550

DISTRIBUTION OF CD, PB AND CU BETWEEN THE DISSOLVED AND PARTICULATE PHASE IN THE EASTERN SCHELDT AND WESTERN SCHELDT ESTUARY, Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie. For primary bibliographic entry see Field 5B. W87-04566

PLUTONIUM AND AMERICIUM IN ARCTIC WATERS, THE NORTH SEA AND SCOTTISH AND IRISH COASTAL ZONES,
Land Univ. (Sweden). Dept. of Radiation Physics. Por primary bibliographic entry see Field 5B. W87-0457

EPIDERMAL TUMORS IN MICROSTOMUS PACIFICUS (PLEURONECTIDAE) COLLECT-ED NEAR A MUNICIPAL WASTEWATER OUTFALL IN THE COASTAL WATERS OFF LOS ANGELES (1971-1983),
Southern California Coastal Water Research
Project Authority, Long Beach.
For primary bibliographic entry see Field 5C.
W87-04601

NICHE CHARACTERIZATION OF DOMI-NANT ESTUARINE BENTHIC SPECIES, State Univ. of New York Coll. at Oswego. Re-

search Center.
R. W. Flint, and R. D. Kalke.
Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 6, p 657-674, June 1986. 5 fig, 4 tab, 57

Descriptors: *Niches, *Estuaries, *Benthos, *Species diversity, *Sediments, *Macroinvertebrates, *Distribution, Ecology, Behavior, Corpus Christi Bay, Texas, Phytoplankton, Productivity, Population density, Food chains, Habitats.

The term niche has been used in a variety of ways by ecologists intrigued with habitat and life history differences of closely related species. In some in-stances the niche has been viewed in distributional units, stressing a spatial concept. Benthic macroin-faunal species in a south Texas esturarine environfamal species in a south Texas esturarine environment were studied over a 2.5 year period to characterize their distributions and ecology. The 13
dominant taxa chosen for investigation exhibited
distinct habitat usage differences as judged both by
the use of discriminant analysis and the differentiation of behavioral characteristics. Species coexistence in the estuarine benthic community of Corpus
Christi Bay was examined with respect to resource
partitioning for such parameters as food and space.
Utilization of these resources by the dominant taxa
differed in both temporal and spatial dimensions,
with the spatial dimension consisting of horizontal
and vertical attributes. Benthic species were separated according to (1) occurrences in certain sediment types with varying organic content, (2) pres-

ence in estuarine regions characterized by different phytoplankton productivity rates, (3) different pe-riods of annual occurrence, and (4) occurrence in different sediment microhabitats characterized by different sediment micronapitats characterized by varying sediment depth and relation to depth of oxygenated sediments. Superimposed upon differences in habitat usage of these species were behavioral traits, such as feeding differences, which further discriminated how benthic species obtained ther discriminated how benthic species obtained resources. Based upon species occurrence in a certain characteristic environment, the authors speculated on the structural division of the benthic habitat by various taxa often classified as common members of the same species' assemblages in the past. Although other investigators have demonstrated the same species' assemblages in the past. past. Attnough other investigators have demonstrated interactions among co-occurring benthic infaunal species, the information presented here illustrated how these species could minimize interactions in order to maintain their populations. (Alexander-PTT)

NITROGEN CYCLE OF AN EAST COAST, U.K. SALTMARSH: II. NITROGEN FIXATION, NITRIFICATION, DENITRIFICATION, TIDAL EXCHANGE.

Essex Univ., Colchester (England). Dept. of Biol-

ogy. A. Aziz, and D. B. Nedwell. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 6, p 689-704, June 1986. 3 fig, 9 tab, 29

Descriptors: *Nitrogen cycle, *Nitrogen fixation, *Saltmarshes, *Nitrification, *Denitrification, *Tides, *Cyanobacteria, Sediments, Ammonium, Nitrates, Detritus, Colne Point, Estuaries, Particu-late matter, Bacteria, Recycling.

Saltmarshes were originally suggested to be major exporters of carbon and nitrogen to associated estuarine and coastal marine ecosystems, although estuarine and coastal marine ecosystems, atmough subsequent work now indicates that net export or import varies widely from marsh to marsh. Measurements of nitrogen fixation (acetylene reduction) showed greatest rates in the saltmarsh pans with a benthic layer of cyanobacteria present. The smallest amount of nitrogen fixation occurred on the marsh surface where a Puccinellia maritima/Hailmione portulacoides plant association shaded the underlying sediment. Phototrophic nitrogen fixation was always greater than dark, chemotrophic, bacterial fixation. Only a small proportion of the total amount of ammonium, which was formed during detrital breakdown, was nitrified to nitrate. Although there is a high capacity for bacteria nitrate reduction in these sediments, the process is limited by low nitrate availability and most nitrate upon reduction is converted to ammonium rather than being denitrified to gaseous products. Denitrication does not, therefore, result in any great loss of nitrogen from the saltmarsh. There was little net subsequent work now indicates that net export or than being denitrified to gaseous products. Denitrification does not, therefore, result in any great loss of nitrogen from the saltmarsh. There was little net import or export of nitrogen on an annual basis, although nitrate and organic-N in small particulate material was removed from tidal water by the marsh, and there was net annual export of ammonium, dissolved organic-N and organic-N in large particulate material. Losses of nitrogen by the small net tidal export and by denitrification were approximately balanced by nitrogen fixation. It was concluded that the nitrogen cycle of the Colne Point saltmarsh was balanced on an annual basis, with most nitrogen being recycled within the marsh. The saltmarsh did not apparently act as a net source of nitrogen for the adjacent estuary, although it may act as an important processor of nitrogen, removing some forms of nitrogen such as nitrate from tidal water while exporting other forms of nitrogen such as dissolved organic-N. (Alexander-PTT)

OCCURRENCE AND RECRUITMENT OF FISH LARVAE IN A NORTHERN NEW ZEALAND ESTUARY, Auckland Univ. (New Zealand). Dept. of Zoolo-

gy.
D. S. Roper.

Estuarine, Coastal and Shelf Science ECSSD3,
Vol. 22, No. 6, p 705-717, June 1986. 4 fig, 2 tab, 32

Descriptors: *Recruitment, *Fish larvae, *Larvae, *Tidal effects, *Population density, *Estuaries, *Harbors, *Tidal currents, Spawning, Settling, Flounder, Fish, Whangateau Harbor, Ebb tides, Frequency distribution.

The importance of estuaries and sheltered inshore areas in the life histories of fish is well established. In particular, these areas have been shown to serve as nurseries for young fish. Unless the fish enter as juveniles, the use of such nursery habitats requires that the larvae spawned outside are recruited in, and, together with those spawned inside, that they avoid being flushed out with the tide. The occurrence of fish larvae and the effect of diel and tidal variation on catches was studied at about biweekly intervals for a year in Whangateau Harbor, a small well mixed northern New Zealand estuary. Larvae from 31 taxa were identified. The annual pattern of larval occurrence was typical for fish in temperate waters, with a major peak of abundance in early summer. For six taxa, larval densities were significantly greater in night-time than in daytime summer. For six taxa, larval densities were significantly greater in night-time than in daytime catches, and analysis of length-frequency distribution suggested that for two species this was due to daytime net avoidance. No significant differences were found between the densities of larvae caught on flood and ebb tides, but changes in length-frequency distributions were significant for two species. Recently hatched larvae of an unidentified goby were found leaving the harbor, where they were probably spawned, while older larvae of the species appeared to be recruiting back in. Larvae of the flounder Rhombosolea plebeis were also apparently recruiting into the harbor. In the absence of a two-layered circulation pattern larvae relied upon tidal transport for recruitment, and probably ensured their retention by rapidly settling to the bottom. (Alexander-PTT)

SEA-LEVEL FLUCTUATIONS IN A COASTAL LAGOON

LAGOON, Delaware Univ., Newark. Coll. of Marine Studies. K. C. Wong. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 6, p 739-752, June 1986. 7 fig. 3 tab, 16 ref. New York Sea Grant Inst. Contract 04-7-158-

Descriptors: *Sea level fluctuations, *Coastal lagoons, *Lagoons, *Tidal amplitude, *Bays, *Coastal waters, *Inlets, Great South Bay, Long Island, Harmonic analysis, Water level fluctuations.

Great South Bay is the largest of a series of inter-connecting, shallow coastal lagoons on the south shore of Long Island, New York. The Bay is approximately 40 km in length (with major axis oriented roughly along the east-west direction) and its width varies from 2.5 km to 8 km. It covers a surface area of about 235 sq km and the average MLW depth is approximately 1.3 m. Sea-level observations made during December, 1979, at six stations in Great South Bay reveal that there were significant subtidal fluctuations in addition to the tidal oscillations. Harmonic analysis of the tidal oscillations of sea level indicates that M sub 2 is the dominant tidal constituent. The M sub 2 amplitude, dominant tidal constituent. The M sub 2 amplitude, however, suffered a more than 50% reduction in the interior of the Bay due largely to the narrow inlet. The subtidal sea level fluctuations within the inlet. The subtidal sea level fluctuations within the Bay were forced primarily by the low-frequency fluctuations of the adjacent shelf water. The active subtidal exchange induced by this Bay-shelf coupling appeared to have suffered only minor attenuation within the Bay. As a consequence, the variance associated with subtidal sea level fluctuations was greater than that associated with the tidal oscillations over most of Great South Bay. (Alexander-PTT) W87-04606

STUDIES ON THE POPULATION ECOLOGY OF UPOGEBIA DELTAURA (LEACH) (CRUSTACEA, THALASSINIDEA), Kristenebergs Marinbiologiska Station, Fiskebackskil (Sweden).

B. Tunberg.

Estuarine, Coastal and Shelf Science ECSSD3,

Vol. 22, No. 6, p 753-765, June 1986. 9 fig, 2 tab, 26

Descriptors: *Population density, *Crustaceans, *Seasonal variation, *Sediments, *Upogebia, *Sweden, Archipelagos, Eggs, Molting.

In the sea, a large exchange of energy and dis-solved substances takes place between the bottom substrate and the water mass. The extent of this exchange is, among other things, dependent on the substrate and the water mass. The extent of this surchange is, among other things, dependent on the sediment surface, water movements over this surface, the thickness of the oxidized layer, and also the degree of bioturbation. Upogebia usually construct deep, extensive burrows in the bottom substrate. Upogebia deltaura was collected quantitatively and qualitatively between June 1980 and August 1982 from a level, sandy bottom at a 12 m depth in the archipelago of Lysekil (on Gullmarsforden) about 70 km north of Goteborg, in western Sweden. A total of 347 individuals were obtained. The deepers burrows reached a depth of more than 65 cm into the substrate. During the cold season, U. deltaura was situated much deeper in the substrate than it was during the summer, probably as a result of 'hiberantion'. The average density was 5.0 individuals/0.1 sg m, and the maximum of 10 specimens was found in one 0.1 sq m sample. Out of the 341 individuals identifiable as to sex, 186 (54.6%) were females and 155 (45.4%) were males. Berried females were found between May and August, and the average number of eggs carried was 4757. females were found between May and August, and the average number of eggs carried was 4757. Ecdysis took place between May and August; most females moulted in the middle of June and most males about one month later, in mid July. The chelipeds of large males were proportionally bigger than were those of large females. Maximum total body length of the females was 65.7 mm, and that of the males was 65.3 mm. (Alexander-PTT) W87-04607

DISTRIBUTION AND NATURE OF ORGANIC MATTER IN RECENT SEDIMENTS OF LAKE NOKOUE, BENIN (WEST AFRICA), Perpignan Univ. (France). Lab. of Marine Sedimentalogy and Geochemistry. F. Gadel, and H. Texier. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 6, p 767-784, June 1986. 8 fig, 3 tab, 36 ref

Descriptors: *Sediments, *Lake Nokoue, *Organic matter, *Limnology, *Lagoons, *Sedimentation, Distribution, Hydrology, Algae, Humic acids, Ac-cumulation, Degradation, Cotonou outlet, Benin, Oueme River, So River.

Coastal lagoons are intermediate areas between Coastal lagoons are intermediate areas between terrestrial and marine environments. They are eutrophic zones of considerable economic importance, mainly for aquaculture. The functional coupling between these ecosystems may comprise physical energy input, flow of dissolved nutrients and living or dead particulate organic matter. Marine and terrestrial influences make these la-Marine and terrestrial influences make these lagoons, areas of high potential productivity and high organic carbon levels. The distribution and nature of organic matter clearly identify the principle sectors of the lagoon which vary according to hydrological and sedimentological conditions. The central area frequently includes coarse ancient fluviatile sediments. The rare organic matter there offers aliphatic and nitrogenous characters which may be derived from both the origin of organic matter (algae and meiofauna) and the level of oxygenation prevailing during deposition. In the southern sector, highly oxygenated conditions resulting from sea currents generated by the Cosouthern sector, highly oxygenated conditions resulting from sec currents generated by the Cotonou outlet could cause the elimination of labile compounds, and hence be responsible for the high degradation state of organic matter. In the western sector, still water conditions allow fine sediments to be deposited. This frequently leads to the accumulation of organic matter showing such reducing conditions that they allow the integration of sulphur in humic compounds and a decrease of their solubility. In the northern area, the contribution of terrestrial material supplied by the Oueme and So rivers is clearly indicated by the low average percentages of hydrolyzable fraction, C/N ratios ranging between 9 and 15, while H/C and N/C ratios are low in humic acids. (Alexander-PTT) W87-04608

CLIMATIC MUDEL
COASTAL CIRCULATION,
Univ. Vancouver. Dept. of CLIMATIC MODEL OF RUNOFF-DRIVEN

Oceanography.
P. H. LeBlond, W. J. Emery, and T. Nicol.
Estuarine, Coastal and Shelf Science ECSSD3,
Vol. 23, No. 1, p 59-79, July 1986. 10 fig, 19 ref.

Descriptors: *Mathematical models, *Runoff, *Tidal currents, *Climates, *Salinity, *Coastal waters, Wave propagation, British Columbia, Entrainment, Outflow, Coriolis force, Friction.

In many coastal regions the freshwater runoff from rivers and streams has a very pronounced effect on water property distributions, the resultant density structure and the large-scale coastal circulation. Discharge sources vary in nature from large river outflows, such as the Nile, the Amazon, the chumbia or the St. Lawrence rivers to more wicely lambia or the St. Lawrence rivers to more wicely outtlows, such as the Nile, the Amazon, the Columbia or the St. Lawrence rivers to more widely distributed sources consisting of a collection of small coastal streams, as found along the coasts of Norway, the eastern U.S.A., Alaska and British Columbia. While large rivers have by far the most dramatic local influence on the coastal ocean, the aggregate effect of runoff spread over a larger coastal region may be significant in determining the nearshore salinity distribution and its associated circulation. A simplified two-layer model is developed to examine long-term effects of freshwater runoff on coastal circulation, with particular emphasis on the coast of British Columbia, Canada. The model handles punctual as well as distributed sources in a parabolic formulation free of any wave propagation, where entrainment, Coriolis force and interfacial friction determine the solution of the properties of the upper layer. Solutions are discussed for a steady coastal flow fed by a uniform runoff distribution and for outflow from a point source. (Alexander-PTT) mbia or the St. Lawrence rivers to more widely

SEDIMENT BALANCE IN

SUSPENDED SEDIMENT BALANCE IN CHANGJIANG ESTUARY, National Bureau of Oceanography, (China). Second Inst. of Oceanography. S. Jilan, and W. Kangshan. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 23, No. 1, p 81-98, July 1986. 16 fig, 2 tab, 7 of coastal and Shelf Science ECSSD3.

ref, append.

Descriptors: *Suspended sediments, *Estuaries, *Sediment budget, *Tidal currents, *Sediment transport, *Changjiang estuary, *Coastal waters, China, Spatial distribution, Dispersion, Turbidity,

Waterways.

The Changjiang Estuary is located on a mesotidal coast and it is a partially mixed estuary. The estuary is wide and shallow, and there are four distributaries separated by islands and shoals. The Changjiang river discharges 4.86 x 10 to the 8th power tons of suspended sediment annually, the fourth largest in world. Attempts have been made to understand qualitatively the transport of suspended sediment in Changjiang estuary were analyzed. Strong interaction between different waterways and the fact that they are wide and shallow both contributed to the great spatial and temporal variability in circulation and suspended sediment transport. Using a flux decomposition formula with the relative depth as the vertical coordinate, it was shown that although tidal dispersion was the main dispersion mechanism in the turbidity maximum zone, dispersions due to circulation effects were also important. (Alexander-PTT) der-PTT) W87-04610

SEASONAL PATTERNS OF GROWTH AND COMPOSITION OF PHYTOPLANKTON IN THE LOWER CHESAPEAKE BAY AND VICIN-

ITY, Old Dominion Univ., Norfolk, VA. Dept. of Bio-

Old Dominion Univ., Nortolk, VA. Dept. of Biological Sciences. H. G. Marshall, and R. Lacouture. Estuarine, Coastal and Shelf Science ECSSD3, Vol. 23, No. 1, p 115-130, July 1986. 5 fig. 21 ref.

Descriptors: *Seasonal variation, *Phytoplankton, *Growth rates, *Species composition, *Coastal

waters, *Chesapeake Bay, *Succession, Bays, Nan-oplankton, Cyanobacteria, Aquatic life.

The earliest comprehensive study of Chesapeake Bay phytoplankton listed 83 diatoms, and 8 dino-flagellates, plus zooplankters. Two annual maxima flagellates, plus zooplankters. Two annual maxima that occurred during spring and fall were noted. A twenty-three month study of lower Cheaspeake Bay phytoplankton was made from February 1982 to December 1983. The major seasonal growth periods were dominated by a diatomaccous flora and a pico-nanoplankton complex composed mainly of cyanobacteria, chlorophytes and other cells < 5 micron in size. There was a pattern of multiple pulses throughout the year. However, the trend for maximum development occurred during the winter-spring and fall periods. The dominant diatoms were Skeletonema costatum, Leptocylindrus danicus, and Asterionella gracialis. Seasonal drus danicus, and Asterionella gracialis. Seasonal comparisons were made to earlier phytoplankton composition studies in the Bay. Over the past 60 there has been a change in phytoplankton blages and concentrations in the Bay. Skeletonema costatum has remained a dominant species, but a more abundant and broader base of small sized, chain-forming diatoms have become estab-lished. In addition, high concentrations of the piconanoplankton, chrysophyceans and cryptophyceans were abundant. (Alexander-PTT) W87-04611

SPATIAL AND TEMPORAL VARIATIONS IN A COMMUNITY OF NEKTOBENTHIC INVER-TEBRATES FROM MORETON BAY, QUEENS-LAND, Australian Museum, Sydney.

A. R. Jones.
Estuarine, Coastal and Shelf Science ECSSD3,
Vol. 23, No. 1, p 131-146, July 1986. 9 fig, 5 tab, 37

Descriptors: *Spatial distribution, *Seasonal varia-tion, *Temporal variation, *Populations, *Bays, *Nektobenthic invertebrates, *Invertebrates, Dius-ralia, Moreton Bay, Sediments, Predation, Salini-ty, Population dynaptics ty, Population dyna

Those large marine invertebrates that are active at or just above the sediment surface form an important community whose abundance can be very high. These invertebrates include portunid, pennigh. These invertebrates include portunid, pen-aeid, carid, scyllarid and stomatopod crustaceans and cephalopod mollusks and have been termed nektobenthos. Temporal and/or spatial community patterns of nektobenthos or the smaller epibenthos have been examined in the Gulf of Mexico but little studied elsewhere. The temporal and spatial patterns in community composition, number of species and number of individuals were described and related to abiotic factors. During warmer months, necturnal periods had more species and and related to aboute factors. During warmer months, nocturnal periods had more species and individuals than diurnal periods and changed com-munity composition. Burrowing in the sediment during daytime caused these changes and probably serves to reduce both predation and energy ex-penditure. Diel differences were reduced or absent penditure. Diel differences were reduced or absent in winter when the community was depauperate. Monthly patterns were highly positively correlated with temperature but not with salinity. These pat-terns were affected by summer migrations of juveniles from very shallow nursery areas. The deepest site varied least over time and was also the most site varied least over time and was also the most individualistic in community composition. Numbers of species and individuals were both positively correlated with distance offshore and depth during most months. These factors probably reflect relative marine influence and environmental stability. The dynamic nature of the community is illustrated by the fact that interaction terms in factorial account of the community is illustrated by the fact that interaction terms in factorial anovas were always significant and thus no spatial or temporal pattern was consistent. (Alexander-PTT W87-04612

POLYCHLORINATED BIPHENYL RESIDUES IN SOME MARINE ORGANISMS FROM THE BAIE DES ANGLAIS (BAIE-COMEAU, QUEBEC, SAINT-LAWRENCE ESTUARY), Department of Fisheries and Oceans, Quebec. Fisheries Research Branch.

Field 2-WATER CYCLE

Group 2L—Estuaries

For primary bibliographic entry see Field 5B. W87-04662

EXTRA INTESTINAL NON-CHOLERA VIBRIO INFECTIONS IN NOVA SCOTIA,
Victoria General Hospital, Halifax (Nova Scotia).
Dept. of Clinical Microbiology.
For primary bibliographic entry see Field 5C.
W87-04672.

TIDE-INDUCED LAGRANGIAN RESIDUAL CURRENT AND RESIDUAL TRANSPORT: 1. LAGRANGIAN RESIDUAL CURRENT, Shandong Coll. of Oceanology (China). S. Feng, R. T. Cheng, and P. Xi. Water Resources Research WRERAQ, Vol. 22, No. 12, p 1623-1634, November 1986, 3 fig. 32 ref,

Descriptors: "Numerical analysis, "Mathematical studies, "Tides, "Tidal currents, "Coastal waters, "Estuaries, "Lagrangian residual current, Eulerian mean velocity, Nonlinear approximation, Drift.

It is more relevant to use a Lagrangian mean velocity than an Eulerian mean velocity to determine the movements of water masses in tidal estuaries and coastal embayments. Under weakly nonlinear approximation, the parameter kapps, which is the ratio of the net displacement of a labeled water mass in one tidal cycle to the tidal excursion, is assumed to be small. Solutions for tides, tidal current, and residual current have been considered for two-dimensional hamptornic estuaries and m assumed to exmail. Southons for tides, tidal current, and residual current have been considered for two-dimensional, barotropic estuaries and coastal sea. Particular attention was paid to the distinction between the Lagrangian and Eulerian residual currents. When kappa is small, the first-order Lagrangian residual is the sum of the Eulerian residual current and the Stokes drift. The Lagrangian residual current the slocked drift. The Lagrangian residual current has been shown to be dependent on the phase of tidal current. The Lagrangian drift velocity is induced by nonlinear interactions between tides, tidal currents, and the first-order residual currents, and takes the form of an ellipse on a hodograph plane. Several examples are given to further demonstrate the unique properties of the Lagrangian residual current. (See also W87-04752) (Rochester-PTT)

TIDE-INDUCED LAGRANGIAN RESIDUAL CURRENT AND RESIDUAL TRANSPORT: 2. RESIDUAL TRANSPORT: 2. RESIDUAL TRANSPORT WITH APPLICATION IN SOUTH SAN FRANCISCO BAY, CALIFORNIA, Shandong Coll. of Oceanology (China). S. Feng, R. T. Cheng, and P. Xi. Water Resources Research WRERAQ, Vol. 22, No. 12, p 1635-1646, November 1986. 3 fig, 34 ref, append.

Descriptors: "Mathematical equations, "Path of pollutants, "Numerical analysis, "Tidal currents, "Coastal waters, "Estuaries, "Sediment transport, 'Lagrangian residual current, Eulerian residual current, Stokes drift, Nonlinear approximation, Drift, San Francisco Bay, California, Convection, Dispersion, Transport, Boundary layers, Solutes.

Dispersion, Transport, Boundary layers, Solutes. A new formulation of an intertidal conservation equation is presented and examined in detail. In a weakly nonlinear tidal estuary, the resultant intertidal transport equation also takes the form of a convection-dispersion equation without the ad hoc introduction of phase effect dispersion in a form of dispersion tensor. The convective velocity in the resultant equation is the first-order Lagrangian residual current (the sum of the Eulerian residual current (the sum of the Eulerian residual current and the Stokes drift). The remaining dispersion terms are important only in high-order solutions; they are due to shear effect dispersion and turbulent mixing. There exists a dispersion boundary layer adjacent to shoreline boundaries. An order of magnitude estimate of the properties in the dispersion boundary layer is given. The present treatment of intertidal transport processes illustrated by an analytical solution for an amphidromic system and by a numerical application in South San Francisco Bay, California. The present

formulation reveals that the mechanism for long-term transport of solutes is mainly convection due to the Lagrangian residual current in the interior of a tidal estuary. This result also points out the weakness of in the tidal dispersion formulation, and explains the large variability of the observed values for tidal dispersion coefficients. (See also W87-04752) (Rochester-PTT)

CHEMICAL CONTROLS ON ECOLOGY IN A COASTAL WETLAND, Pennsylvania State Univ., University Park. Dept.

of Geosciences. W. H. Casey, A. Guber, C. Bursey, and C. R.

Eos EOSTA, Vol. 67, No. 45, p 1305, 1310, November 11, 1986. 7 fig, 25 ref.

Descriptors: *Radioisotopes, *Saline soils, *Sediments, *Fallout, *Salt marshes, *Plant growth, Desiccation, Transpiration, Evaporation, Palus crisium site, Chincoteague Bay, Virginia, Seasonal

The relation of seasonal cycles of desiccation and plant growth to the transport of natural and fallout radionuclides was studied at the Palus Crisium site (Chincoteague Bay, Virginia). Seasonal cycles influence many important aspects of sediment chemistry at the Palus Crisium site. Pore water profiles are controlled by the composition of waters on the marsh surface, which vary throughout the year by evaporation and by plant transpiration. Because transpiration removes much water from the sediment, the seasonal variations in pore fluid salinity are related to the metabolic activity of the marsh grasses. These processes result in salinity profiles that vary throughout the year and result in hypersaline conditions near the sediment surface in summer. These seasonal cycles indirectly affect the movement of trace radionuclides in marsh sediments. summer. These seasonal cycles indirectly affect the movement of trace radionuclides in marsh sediment. Foliage preferentially traps wet and dry deposition from the atmosphere; thus portions of the marsh with rich foliage have a larger inventory of atmospherically detrived nuclides than poorly vegetated areas. The chemistry of pore fluids in marsh sediment also affects the transport of nuclides. Hypersalinity and low pH of marsh sediments causes some nuclides to desort from particles and thus become transported from the marsh sediment as solutes. All of these processes cause heterogeneous lateral and vertical distributions of atmospherically derived nuclides and other trace substances. (Rochester-PTT)

COMPARATIVE STUDY OF DECOMPOSI-TION, OXYGEN CONSUMPTION AND NU-TRIENT RELEASE FOR SELECTED AQUATIC PLANTS OCCURRING IN AN ESTUARINE EN-

VIRONMENT,
Maryland Univ., Cambridge. Horn Point Environmental Labs.

mental Laos. R. R. Twilley, G. Ejdung, P. Romare, and W. M. Kemp. OIKSAA, Vol. 47, No. 2, p 190-198, September 1986. 5 fig, 1 tab, 57 ref. EPA Grant R 805932-1.

Descriptors: *Aquatic plants, *Decomposition, *Oxygen requirements, *Nutrient requirements, *Estuarine environment, *Phytoplankton, Algae, Macrophytes, Spartina, Choptank River, Nitrogen, Plant tissues, Carbon, Phosphorus, Leaching.

The rates of decomposition and nutrient regenera-tion were compared among six aquatic plants rep-resenting examples from phytoplankton, macroal-gae, submersed vascular macrophytes and marsh grasses. The plants were obtained from the Chop-tank River, Maryland, except for phytoplankton, and were placed in mesh bags and incubated in aquaria with ambient water for 93 days under dark, acrated, temperature controlled conditions. De-composition rates based on both decrease in origi-nal mass and associated oxygen consumption were determined. The rates were directly proportional to the initial nitrogen content of the plant tissues. Nitrogen content of all plant tissues increased during decomposition, but reductions of carbon to nitrogen ratios were only observed for those plants

with an initial carbon to nitrogen ratio greater than 20. Nitrogen to phosphorus ratios generally increased due to a much higher leaching for phosphorus as compared with nitrogen. The leached phosphorus was equally distributed between dissolved inorganic and organic forms. Generally, the magnitude of phosphorus and nitrogen leaching rate was not related to respective initial plant nutrient concentrations, nor to the plant's structural integrity. Total nitrogen phosphorus dissolved in the water column plus that in the plant material remaining in the mesh bags at the end of the experiment accounted for 7 to 48% of their original respective quantities for submersed macrophytes compared with 82-94% for Spartina. (Author's abstract) thor's abstract)

IMPLICATIONS OF SEDIMENTOLOGICAL AND HYDROLOGICAL PROCESSES ON THE DISTRIBUTION OF RADIONUCLIDES: THE EXAMPLE OF A SALT MARSH NEAR RAVENGLASS, CUMBRIA, Institute of Oceanographic Sciences, Taunton (Excland).

(England).

For primary bibliographic entry see Field 5B. W87-04873

STATISTICAL ANALYSIS OF ESTUARINE PROFILES: III. APPLICATION TO NITRATE, NITRITE AND AMMONIUM IN THE TAMAR

STUARY,
Marine Biological Association of the United Kingdom, Plymouth (England).
For primary bibliographic entry see Field 5B.
W87-04874

POINT-SOURCE INPUTS OF PETROLEUM WASTEWATER INTO THE NIGER DELTA, NI-

WASTEWARD CONTROL OF Science and Technology, Rivers State Univ. of Science and Technology, Port Harcourt (Nigeria). Inst. of Pollution Studies. For primary bibliographic entry see Field 5B.

AMMONIFICATION'S ACTIVITY IN SEA-WATER AND SEDIMENTS OF THE CADIZ BAY (SW SPAIN) (AMONIFICACION EN AGUAS Y SEDIMENTOS MARINOS DE LA BAHIA DE CADIZ (SO DE ESPANA)), Instituto de Ciencias Marinas, Andalucia (Spain). For primary bibliographic entry see Field 5B. W87-04915

ESTUARINE AREAS OF PERNAMBUCO (AREAS ESTUARINAS DE PERNAMBUCO), (AREAS ESTUARINAS DE FERNAMBUCO), Universidade Federal de Pernambuco, Recife (Brazil). Dept. de Oceanografia. P. A. Coelho, and M. F. A. Torres. Trabalhos Oceanograficos, Vol. 17, p 67-80, 1982. 8 fig. 1 tab. 21 ref

Descriptors: *Mapping, *Remote sensing, *Aerial photography, *Estuaries, *Aquaculture, *Mangrove swamps, *Brazil, Photography, Swamps.

The available estuarine and mangrove areas of Pernambuco State (Brazil) were studied for aquaculture utilization. Comparisons were carried out on 21 maps at 1:25,000 scale of the Northeast region of Brazil, and aerial photographs at 1:30,000 scale were interpreted. It was calculated that estuarine areas comprised 25,044 ha of Pernambuco State in 1970-1971, of which 7,672 ha were water and 17,372 ha consisted of mangrove. (Author's abstract!)

ECOLOGICAL STUDIES OF THE REGION OF ITAMARACA-PERNAMBUCO-BRAZII. XXIII. HYDROLOGICAL CONDITIONS OF THE RIO BOTAFOGO ESTUARY (ESTUDOS ECOLOGICOS DA REGIAO DE ITAMARACA-PERNAMBUCO-BRASII. XXIII. CONDICOES HIDROLOGICAS DO ESTUARIO DO RIO BOTA-FOGO), Universidade Federal de Pernambuco, Recife

Estuaries-Group 2L

(Brazil). Dept. de Oceanografia. S. J. de Macedo, H. N. S. Melo, and K. M. P. da Costa. Trabalhos Oceanograficos, Vol. 17, p 81-122, 1982. 12 fig. 17 ref

Descriptors: *River basins, *Brazil, *Estuaries, *Tidal effects, *Tides, Transparency, Optical properties, Temperature, Water temperature, Physical properties, Ecology, Hydrology, Salinity, Acidity, Oxygen, Dissolved oxygen, Biochemical oxygen demand, Nitrates, Nitrites, Phosphates, Nitrogen,

Hydrological parameters were studied in the Botafogo River basin, a part of the Pernambuco-Brasil
littoral region. Parameters studied included transparency, temperature, salinity, pH, dissolved
oxygen, biochemical oxygen demand, nitrite-N, nitrate-N, and phosphate-P. Parameters were influenced mostly by sample location and oscillation of
the tides. During low tide in the inferior course of
the estuary, values of transparency, salinity, dissolved oxygen, and pH were low, while nitrate-N,
phosphate-P, and biochemical oxygen demand
were high. (Author's abstract)
W87-04917

REPRODUCTIVE FAILURE IN COMMON SEALS FEEDING ON FISH FROM POLLUTED COASTAL WATERS, Rijksinstituut voor Natuurbeheer, Texel (Netherlands). Dept. of Estuarine Ecology. For primary bibliographic entry see Field 5C. W87-04986

EFFECT OF MISSISSIPPI RIVER DELTA LOBE DEVELOPMENT ON THE HABITAT COMPOSITION AND DIVERSITY OF LOUISI-ANA COASTAL WETLANDS,
Louisiana State Univ., Baton Rouge, Coastal Ecol-

Louisiana State Univ., Baton Rouge. Coastal ogy Lab. For primary bibliographic entry see Field 2J. W87-05032

CARBON-13 NMR STUDIES OF SALT SHOCK-INDUCED CARBOHYDRATE TURNOVER IN THE MARINE CYANOBACTERIUM AGMENELLUM QUADRUPLICATUM, California Univ., Berkeley. Lawrence Berkeley

I ah E. Tel-Or, S. Spath, L. Packer, and R. J.

Mehlhorn.
Plant Physiology PLPHAY, Vol. 82, No. 3, p 646-652, November 1986. 4 fig. 1 tab, 16 ref. NIH Grant AG-04818, DOE Contract DE-AC03-76SF00098 and DOE Grant DE-AT03-ER10637.

Descriptors: *Nuclear magnetic resonance, *Salin L'examptors: 'Auctear magnetic resonance, 'Salini-ty, 'Carobodydrate turnover, 'Metabolism, 'Cyan-obacteria, 'Salt stress, Isotope studies, Spectral analysis, Osmoregulation, Nutrients, Bioaccumula-tion, Cells, Plant physiology.

Salt-tolerant cyanobacteria synthesize low mol wt organic solutes when grown at supraoptimal NaCl concentrations. In general, the major compound(s) synthesized by a cyanobacterium correlates with the maximum salt concentration the strain tolerthe maximum salt concentration the strain tolerates. Thus, freshwater strains, Le. those whose maximum salinity tolerance is about 0.9 M NaCl or less, synthesize glucosylglycerol. Carbon turnover in response to abrupt changes in salinity, including the mobilization of glycogen for use in osmoregulation was studied with pulse-chase strategies utilizing nuclear magnetic resonance (NMR)-silent and NMR-detectable 12C and 13C isotopes, respectively. Growth of Agmenellum quadruplicatum in 30%-enriched 13C bicarbonate provided sufficient NMR-detectability of intracellular organic camoregulants for these studies. A comparison of ficient NMR-detectability of intracellular organic osmoregulants for these studies. A comparison of NMR spectra of intact cells and their ethanol extracts showed that the intact cell data were suitable for quantitative work, and, when combined with ESR measurements of cell volumes, yielded intracellular glucosylglycerol concentrations without disrupting the cells. NMR pulsechase experiments were used to show that 13C-enriched glycogen, which had previously been accumulated by the cells under nitrogen-limited

growth at low salinities, could be utilized for the synthesis of glucosylglycerol when the cells were abruptly transferred to hypersaline media, but only in the light. It was also shown that the accumulation of glucosylglycerol in the light occurred on a time scale similar to that of cell doubling. Depletion of glucosylglycerol when cells abruptly transferred to lower salinities appeared to be rapid-the intracellular pool of this omnoregulant was decreased 2-fold within 2 hours of hypotonic shock. (Alexander-PTT) (Alexander-PTT) W87-05037

SPAWNING STOCK-RECRUITMENT RELA-TIONSHIPS AND ENVIRONMENTAL INFLU-ENCES ON THE TIGER PRAWN (PENAEUS ESCULENTUS) FISHERY IN EXMOUTH GULF, WESTERN AUSTRALIA, Western Australian Marine Research Labs., Perth. For primary bibliographic entry see Field 81.

COMPOSITION, SEASONALITY AND DISTRI-BUTION OF ICHTHYOPLANKTON IN PORT PHILLIP BAY, VICTORIA, Melbourne Univ., Parkville (Australia). Dept. of

Zoology. G. P. Jenkins.

Australian Journal of Marine and Freshwater Re-search AJMFA4, Vol. 37, No. 4, p 507-520, 1986. 8 fig, 2 tab, 42 ref.

Descriptors: *Species composition, *Seasonal variation, *Ichthyoplankton, *Seasonal distribution, *Population dynamics, *Plankton, Port Philip Bay, Bays, Fish eggs, Taxonomy, Spawning, Zooplankton, Migration, Larvae, Coastal waters, Australia.

Bays, Fish eggs, Taxonomy, Spawning, Zooplankton, Migration, Larvae, Coastal waters, Australia. Plankton samples were collected on monthly cruises over 1 year from May 1983 to April 1984, to investigate composition, seasonality and distribution of ichthyoplankton in Port Phillip Bay, Fish egg numbers were dominated by the southern anchovy, Engraulis australis; clupeoids, and gobiids were co-dominant larvae. Other common fish larvae were the cobbler, Gymnapistes marmoratus, greenback flounder. Rhombosolea tapirina, and callionymids. Egg abundances were highest in summer and winter-spring. The summer period was dominated by clupeoid and gobiid larvae, together with callionymids, and monocanthids, platycephalids, blenny, Pictiblennius tasmanianus, the snapper, Chrysophrys auratus, and anumber of rarer species. The winter-spring period was almost entirely dominated by four taxa: gobiids, G. marmoratus, R. tapirina and the long-snouted flounder, Ammortretis rostratus. Eggs of E. australis, Sardinops neopilchardus and A. rostratus, and larvae of all common taxa except monacanthids and C. auratus, were distributed widely throughout the bay. Abundance of eggs of E. australis at the mouth of the bay was significantly lower than within the bay proper. Larvae of P. australis at the mouth of the bay whereas C. auratus larvae were only collected at stations well inside the bay. Analysis of winter samples revealed multispecies patchiness of fish larvae, and a positive correlation between larval abundance and volume of net zooplankton. Although juveniles of King George whiting, Sillaginodes punctatus, and yellow-eyed mullet, Aldrichetia forsteri, are abundant in Port Phillip Bay, larvae were virtually absent. It is proposed that these species spawn offshore, and that immigration into the bay occurs at a late larval-early juvenile stage not detectable by plankton sampling. (Author's abstract)

SPATIAL PATTERNS IN THE MACRO-BENTHIC COMMUNITIES OF THE HAWKES-

BENTHIC CUMMUNITIES OF THE HAWKES-BURY ESTUARY, NEW SOUTH WALES, Australian Museum, Sydney. A. R. Jones, C. J. Watson-Russell, and A. Murray. Australian Journal of Marine and Freshwater Re-

search AJMFA4, Vol. 37, No. 4, p 521-543, 1986. 6 fig, 5 tab, 46 ref, append.

Descriptors: *Spatial distribution, *Estuaries, *Benthic fauna, *Species composition, *Macrobenthos, *Baseline studies, Salinity, Sediments, Sand, Clay, Hawkesbury Estuary, Australia.

Sand, Clay, Hawkesbury Estuary, Australia.

Spatial patterns in the number of species, number of individual animals and community composition of the benthos of the Hawkesbury Estuary, N.S.W., are described and related to physicochemical factors. Replicate grabs were taken from deep and shallow sites located on transects across the estuary for each of five times at intervals of 3 months. The number of species and number of individuals always differed significantly along the estuary but the pattern of difference varied with both depth and time. Although a monotonic decline in the number of species along the estuary hut the pattern of difference varied with salinity than with sedimentary variables but salinity correlations were not always significant. The number of individuals was not related to any abiotivariable in a consistent way. Significant depthrelated differences occurred only for the number of individuals although the pattern of difference varied among both transects and times. Sediment-associated differences also varied with transect and time. Where consistent difference occurred, highest species numbers were sometimes associated with sand and sometimes with coherent clay. Consequently the species-sediment relationship is not always a simple linear function of grain size and different aspects of sediment structure may be influential. Classification and ordination analyses revealed major patterns in community composition that were most closely related to aslinity and fluential. Classification and ordination analyses re-vealed major patterns in community composition that were most closely related to salimity and minor patterns related to sediment grade. Commu-nity changes did not always correspond with phys-icochemical changes and hence the latter were not always good predictors of biological variables. (Author's abstract) W87-05045

BENTHIC MACROFAUNAL PRODUCTION IN THE BAY OF FUNDY AND THE POSSIBLE EFFECTS OF A TIDAL POWER BARRAGE AT ECONOMY POINT - CAPE TENNY,

Department of Fisheries and Oceans, St. Andrews (New Brunswick).

D. J. Wildish, D. L. Peer, and D. A. Greenberg. Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 43, No. 12, p 2410-2417, December 1986. 6 fig, 5 tab, 20 ref.

Descriptors: *Benthic fauna, *Productivity, *Bay of Fundy, *Tidal barrages, *Sediments, *Biomass, Barriers, Turnover, Tidal currents, Mapping, Re-

The distribution of macrofaunal productivity in the Bay of Fundy, inclusive of the upper Bay (Chignecto Bay and Minas basin) is presented. The data used in mapping are based on wet biomass from 266, 0.1- and 0.5-sq m grab samples, converted to annual productivity using a lifespan/annual turnover regression. Macrofaunal production of the subtidal area (1149 sq km) of the whole Bay of Fundy is estimated to be 2120000 t wet biomass/yr equivalent to 190 g wet wt/sq m/yr. Production in the intertidal area (1437 sq km), by contrast, is estimated to be 13000 t wet biomass/yr or 92 g wet wt/sq m/yr. Possible qualitative macrofaunal estimated to be 130000 t wet biomasa/yr or 92 g wet wt/sq m/yr. Possible qualitative macrofaunal changes resulting from building a tidal barrage between Economy Point and Cape Tenny are suggested on the basis of predicted physical changes, particularly tidal current speed, sediment type, and sediment bed stress. The only quantitative prediction possible with the available possible tiological data is that suspension-feeding animal production will be 17% less in the lower Bay of Fundy following barrage construction. This reduction is not significant at the 95% confidence level. (Author's abstract) thor's abstract)

Field 2—WATER CYCLE

Group 2L—Estuaries

ANALYSIS OF LONG-TERM ECOLOGICAL DATA USING CATEGORICAL TIME SERIES Martin Marietta Environmental Systems, Colum-For primary bibliographic entry see Field 8I. W87-05049

USE OF HATCHERY COHO SALMON (ON CORHYNCHUS KISUTCH) PRESMOLTS TO REBUILD WILD POPULATIONS IN OREGON COASTAL STREAMS, Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.

For primary bibliographic entry see Field 8I. W87-05050

ALGAL PICOPLANKTON FROM MARINE AND FRESHWATER ECOSYSTEMS: A MULTI-DISCIPLINARY PERSPECTIVE, Department of Fisheries and Oceans, Vancouver (British Columbia). West Vancouver Lab. For primary bibliographic entry see Field 2H. W87-05053

EFFECT OF TEMPERATURE ON DEVELOP-MENT AND REPRODUCTION IN CHORDA FILUM AND C. TOMENTOSA (PHAEO-PHYTA, LAMINARIALES) FROM NOVA SCOTIA, National Research Council of Canada, Halifax (Nova Scotia) Atlantic Regional Lab

Novaczek, C. J. Bird, and J. McLachlan. Canadia, Halifax (Nova Scotia). Atlantic Regional Lab.

I. Novaczek, C. J. Bird, and J. McLachlan.
Canadian Journal of Botany CJBOAW, Vol. 64, No. 11, p 2414-2420, November 1986. 9 fig, 2 tab, 16 ref.

Descriptors: *Temperature effects, *Sporophytes, *Survival, *Reproduction, *Gametophytes, Fertili-ty, Nova Scotia, Gulf of St. Lawrence, Temperare, Cultures, Seasonal variation

The occurrence of sporophytes of Chorda tomen-tosa and C. filum in the southern Gulf of St. tosa and C. filum in the southern Gulf of St. Lawrence was correlated with the field tempera-ture regime. Temperature tolerances of gameto-phytes and young sporophytes of both species were tested in culture, using isolates from both the gulf and the outer Atlantic coast of Nova Scotia. Chorda tomentoas sporophytes appeared in late winter when the water surface was frozen, were fertile from April to June, and died when water temperature approached 20 C. In culture, sporo-phytes tolerated - 1 to 15 C but became moribund at 20 C. Gametophytes in constant temperature at 20 C. Gametophytes in constant temperature reproduced readily at 5 C, occasionally at 0 and 10 C, but not at higher temperatures; they survived to 24 C. After 6 months in dim light at 10 C some 24 C. After 6 months in dim light at 10 C some gametophytes also released gametes at 15 C. Sporophytes of C. filum appeared in the field in spring after the water temperature had risen above 1 C and persisted through the warm months. New sporophytes appeared in the autumn after the water temperature dropped below 15 C but did not survive the winter. In culture, sporophytes died at -1 and 28 C and survived between 0 and 24 C. Gametophytes reproduced readily from 5 to 12, rarely at 0 and 15 C, and not at higher temperatures. Gametophytes of both species survived 5 months in 0 + or -2 C, < or = 1 micro-E/sq m/s. (Author's abstract) (Author's abstract) W87-05057

VEGETATION-ELEVATION CORRELATION IN TWO DYKED MARSHES OF NORTHEAST-ERN VANCOUVER ISLAND: A MULTIVAR-IATE ANALYSIS, British Columbia Univ., Vancouver. Dept. of

G. E. Bradfield, and A. Campbell. Canadian Journal of Botany CJBOAW, Vol. 64, No. 11, p 2487-2494, November 1986. 2 fig, 4 tab,

Descriptors: *Diked marshes, *Wetlands, *Aquatic planta, *Correlation analysis, *Mathematical studies, *Multivariate analysis, *Tidal marshes, *Species composition, Remote sensing, Grasses, Coastal waters, Marshes, Vegetation, Elevation.

Vegetation - substratum elevation relationships in the Kokish and Cluxewe tidal marshes on northeastern Vancouver Island were examined using principal components analysis, canonical correlation analysis, and multivariate analysis of variance. Both marshes have similar undiked vegetation with low-elevation Carex lyngbyei dominated stands and higher elevation mixed-grass swards of Festuca rubra, Deschampia cespitosa, Hordeum brachyantherum, and Agrostis stolonifera. Diked areas were less comparable in their vegetation as a result of a variety of disturbances in the past. Elevation showed a stronger connection with continuous compositional change in undiked than in diked areas, but less than half of the total vegetation variation was explained. Plant community classifications, based on aerial photographs, accounted for high proportions of the total vegetation variation (87-99%) and residual variation (62-97%) remaining after the 'effect of elevation' had been removed from the vegetation data, using regression analysis. This suggests that the plant communities recognized are distinct units but that factors unrelated to elevation are mainly responsible for their formation. (Author's abstract) Vegetation - substratum elevation relationships in munities recognized are distinct units but that fac-tors unrelated to elevation are mainly responsible for their formation. (Author's abstract)

ECOLOGICAL INTERPRETATION OF THE CHEMISTRY OF MIRE WATERS FROM SE LECTED SITES IN EASTERN CANADA, Durham Univ. (England). Dept. of Botany. For primary bibliographic entry see Field 2K. W87-05061

SHAPE AND POSITION OF THE SALT WATER WEDGE IN COASTAL AQUIFERS,
Technische Hogeschool Delft (Netherlands). Dept.
of Civil Engineering.
For primary bibliographic entry see Field 2F.
W87-05106

GEOCHEMICAL AND GEOPHYSICAL STUD-IES OF SALT WATER INTRUSION IN COAST-Andhra Univ., Waltair (India). Dept. of Geophys-

No. P. R. Prasad, A. Pekdeger, and W. Ohse.
IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the
XVIIIth General Assembly of the International
Union of Geodesy and Geophysics, Hamburg, FR
Germany, August, 1983. IAHS Publication No.
146. p 209-218, 3 fig, 2 tab, 13 ref.

Descriptors: *Geochemistry, *Geophysics, *Saline water intrusion, *Coastal waters, Conductivity, Clays, Saline water, Brackish water, Peat, West Germany, Resistivity, Organic matter.

In coastal regions, detection of salt water intrusion by geoelectrical survey is difficult. The similarity in electrical conductivity between clay, salt water and brackish water in sandy aquifers limits resolution by sounding methods. The effectiveness of other geophysical methods to distinguish salt water is confounded in the presence of layers of peat. A combined approach, using geological, geochemical and geophysical methods, was explored to quantify soil water intrusion across the northwest coast of Schleswig-Holstein, FR Germany. A transect extending to about 19 km from the coast was studied. Observed geochemical data were compared with simulated values of sea water intrusion, based on thermodynamic principles. These comparison were used to confirm deductions drawn from the combined approach. Based on consistency in results between methods, a low resistivity near the coast was interpreted as clay layers enriched in adsorbed salts of marine origin. Oversaturation of terrestrial minerals in solution was shown to result from high concentrations of organic matter in the surface regions adjoining the shoreline. (See also W87-05109) (Author's abstract)

ALT CONTAMINATION OF A COASTAL CONFINED AQUIFER,
Mie Univ., Tsu (Japan). Dept. of Geography.
For primary bibliographic entry see Field 5B.

W87-05120

GROUNDWATER CHEMISTRY IN THE HAM-BURG REGION,
Geologisches Landesamt Hamburg (Germany,

F.R.). For primary bibliographic entry see Field 5B. W87-05125

GEOGENIC GROUNDWATER POLLUTION IN THE HAMBURG REGION, FR GERMANY, For primary bibliographic entry see Field 5B. W87-05126

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALINATION OF SEA-WATER BRACKISH WATER: THE CURRENT STATE
OF THE ART AND A REVIEW OF PROBLEMS AND FUTURE DEVELOPMENTS,

Aqua AQUAAA, No. 5, p 242-248, 1986. 3 fig, 6 ref.

Descriptors: *Desalination, *Reviews, *Water treatment, *Desalination plants, *Brackish water, *Sea water, *Ion exchange, *Distillation, *Demineralization, *Electrodialysis, *Reverse osmosis, Calcium carbonate, Calcium sulfate, Calcium plants of the company of phate, Oxygen, Ammonia, Mussels, Disc

Well-known methods of desalination of sea water and brackish water are reviewed, as follows: distil-lation, demineralization by ion exchange, and de-salination using membranes. Distillation methods are the multi-stage flash method or the multi-effect distribution accessed for the contract of forcing the contract of are the multi-stage flash method or the multi-effect distribution process; important factors affecting the performance of distillation systems are suspended matter, calcium carbonate, calcium sulfate, calcium phosphate, caygen, ammonia, and the presence of mussels, which may proliferate within the tubes. Demineralization by ion exchange should be considered for low levels of total dissolved solids; much progress has been made in this process in recent years, particularly in the area of improved resins leading to greater exchange capacity for the same price. Reverse osmosis (or hyperfiltration) can be accomplished with many different types of membrane, but the following problems remain: reduction in water flow, reduction in salt retention, and increase in pressure. Future developments in and increase in pressure. Future developments in desalination are likely to be in the areas of electrodialysis and use of reverse osmosis membranes with hollow fibers. (Rochester-PTT) W87-04784

3B. Water Yield Improvement

REHABILITATION OF WATERWELLS IN TU-NISIA (REGENERATION DE FORAGES EN

TUNISTE,
Deutsche Gesellschaft fuer Technische Zusammenarbeit G.m.b.H., Eschborn (Germany, F.R.). Aqua AQUAAA, No. 5, p 291-292, 1986. 2 fig.

Descriptors: *Corrosion, *Well function, *Water supply development, *Tunisia, Scaling, Fouling, Acidification, High pressure water jet, Chemical treatment, Pneumatic pumps, Pilot plants, Germa-ny, International agreements.

Incrustation and corrosion problems required 25% of the wells drilled annually in Tunisia to be used for replacement of wells that could not be rehabilitated by conventional methods (e.g., brushing and acidifying). The introduction of modern equipment (high pressure waterjet, balanced chemical treatment, and pneumatic pumps) resulted in a large number of these wells being rehabilitated. They regained their initial efficiency at about 15% of the

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 3

Conservation In Agriculture—Group 3F

cost of a new well. During the pilot phase of technical cooperation between the German Federal Republic and Tunisia, (1984/1985), 23 waterwells to depths up to 290 m were rehabilitated with very good results. (Author's abstract) W87-04796

MICROCATCHMENT WATER HARVESTING FOR RAISING JUJUBE ORCHARDS IN AN ARID CLIMATE,

Indian Council of Agricultural Research, New Delhi.

Deim.
K. D. Sharma, O. P. Pareek, and H. P. Singh.
Transactions of the ASAE TAAEAJ, Vol. 29, No.
1, p 112-118, January-February 1986. 9 fig, 2 tab,
24 ref.

Descriptors: *Microcatchment areas, *Catchment areas, *Arid climates, *Fruit crops, *Orchards, *Water harvesting, *Rainfall-runoff relationships, Runoff, Slope, Soil moisture, Plant growth, Crop yield, India.

Microcatchment water harvesting is presently practiced in dry tracts in North Africa, Afghanistan, Australia, India, Israel, Mexico and Pakistan. In this system the surface runoff is collected from a contributing area over a flow distance of less than 100 m and stored for consumptive use in an adjacent infiltration basin. Microcatchments having different combinations of slopes (0, 0.5, 5 and 10%), slope lengths (3.0, 5.12, 7.0, 8.5, 10.75 and 14.5 m) and contributing areas (0, 31.5, 54, 72, 99 and 144 sq m/tree) aimed at generating runoff supplements of 0 to 400 mm were studied for a period of seven years to determine their runoff yield, soil moisture storage, growth, yield, fruit characteristics, and long term runoff behavior under hot arid conditions in India. In general, runoff and soil moisture storage increased significantly with increasing slope, and decreasing slope length and contributing area; the highest being at 10% slope, 5.12 m slope length and 341.5 sq m/tree contributing area. Similar trends were observed for growth parameters, yield and fruit characteristics of jujube. It was also found that jujube yield was a function of the available soil moisture storage. Over a period of seven years the threshold rainfall reduced by half and runoff efficiency doubled due to the formation of a nearly impervious soil crust over the microcatchment surface. (Alexander-PTT)

3C. Use Of Water Of Impaired Ouality

TOLERANCE OF HOLCUS LANATUS AND AGROSTIS STOLONIFERA TO SODIUM CHLORIDE IN SOIL SOLUTION AND SALINE SEDAY

SPRAY, Liverpool Univ. (England). Dept. of Botany. M. Ashraf, T. McNeilly, and A. D. Bradshaw. Plant and Soil PLSOA2, Vol. 96, No. 1, p 77-84, 1986. 2 fig. 2 tab, 10 ref.

Descriptors: *Water pollution effects, *Salinity, *Sodium chloride, *Soil solution, *Salt tolerance, *Plant pathology, Agrostis stolonifera, Holcus lanatus, Sea cliffs, Saline soils, Plant ecology.

Inland and sea cliff populations of both Agrostis stolonifera L. and Holcus lanatus L. were subjected to soil NaCl treatments, of 100 and 200 mole/cu m NaCl, and tolerance examined using plant dry weight data. A parallel experiment subjected them to salt spray treatments of 2.5%, 5%, and 10% NaCl in distilled water, and tolerance assessed from leaf damage. Both populations of each species were equally sensitive to soil NaCl. When subjected to salt spray, however, the sea cliff populations showed marked resistance to leaf damage. Soil salinity resistance and salt spray resistance thus appear to be independent characteristics in these two species. (Author's abstract)

SALT TOLERANCE OF CHAMOMILLA RECU-TITA (L.) RAUSCHERT TISSUE CULTURES, Univerzita Pavla Jozefa Safarika, Kosice (Czecho-

slovakia). Dept. of Special Biology. E. Cellarova, K. Repcakova, and R. Honcariv. Biologia Plantarum BPABAJ, Vol. 28, No. 4, p 275-279, 1986. 1 fig. 1 tab, 11 ref.

Descriptors: *Soil analysis, *Salt tolerance, *Salinity, *Plant growth, *Salts, *Chamomilla recutita, *Saline soils, Agriculture, Ions, Nutrients, East Slovakia.

One of the most important environmental factors affecting crop production is excess salt in the soil. One possible way to overcome this problem is through agricultural practice. On the other hand, it is necessary to focus introduction of tissue culture methods in plant breeding on efforts to produce varieties of plants with an increased ability to grow in available natural environments with a minimum of energy intensive environmental modification. Another way is to choose the plant species of economic importance which may naturally tolerate high salt concentration. In a recent study salt tolerance of Chamomilla recutita (L) Rauschert tissue culture which is considered as one of the most important medicinal plant species for field cultivation in the East Slovakia salt soil lowland was studied. The results revealed the possibility of utilization of the East Slovak salt soil lowland for large-scale cultivation of the important medicinal plant. (David-PTT)

INFECTION WITH POWDERY MILDEW CAN ENHANCE THE ACCUMULATION OF PRO-LINE AND GLYCINEBETAINE BY SALT STRESSED BARLEY SEEDLINGS,

Lancaster Univ., Bailrigg (England). Dept. of Biological Sciences.

A. J. Murray, and P. G. Ayres. Physiological and Molecular Plant Pathology, Vol. 29, No. 2, p 271-277, 1986. 4 fig, 2 tab, 24 ref.

Descriptors: *Water pollution effects, *Tissue analysis, *Plant diseases, *Salinity, *Infection, *Mildews, *Accumulation, *Proline, *Glycinebetaine, *Salt tolerance, *Barley, *Seedlings, Plant tissues, Nitrogen, Metabolism, Osmotic pressure, Root development, Nitrates, Ammonium, Ions, Amino acids.

The accumulation of proline and betaine by mildewed barley in response to salt stress and the effects of stress and infection on shoot dry weight were investigated using plants grown in sand culture. Because of the dependence of proline and betaine synthesis on nitrogen metabolism, tissue contents of nitrate, amino acids, and ammonium ions were also determined. Uninfected and infected plants showed similar changes in water content and osmotic potential when similar concentrations of NaCl were applied. Concentrations above 50 millimolar reduced shoot dry weight and infection increased the severity of this reduction especially at lower salt concentrations. Above the 50 but not at the 400 millimolar concentration level, salt stressed infected plants accumulated more proline in shoots than did similarly stressed controls. At the 400 millimolar concentration level, shoots of uninfected and infected plants accumulated proline to the same extent. Infection had no effect at any stage on proline levels in roots which remained low in salt stressed plants. Infection only promoted accumulation of betaine at 200 and 400 millimolar. Infection promoted the salt induced accumulation of ammonium ions by shoots, but had no effect on ammonium ions by shoots, but had no effect on ammonium ions by shoots, but had no effect on ammonium ions by shoots, but had no effect on ammonium ions by shoots, but had no effect on ammonium ions by shoots, but had no effect on ammonium ions by shoots, but had no effect on ammonium ions by shoots, but had no effect on ammonium ions by shoots, but had no effect on ammonium ions by shoots, but had no effect on ammonium ions by shoots, but had no effect on ammonium escumulation escumulation escumulation of ammonium ions by shoots, but had no effect on ammonium ions by shoots, but had no effect on ammonium ions by shoots, but had no effect on ammonium ions by shoots, but had no effect on ammonium ions by shoots, but had no effect on ammonium ions by shoots, but had no effect on effect on effect on effe

SALT RESISTANCE OF CHICKPEA GENO-TYPES IN SOLUTIONS SALINIZED WITH NACL OF NA2SO4

TYPES IN SOLUTIONS SALINIZED WITH NACL OR NAZSO4, Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water.
D. J. Lauter, and D. N. Munns.
Plant and Soil PLSOA2, Vol. 95, No. 2, p 271-279,

1986. 5 fig, 1 tab, 12 ref.

Descriptors: *Water pollution effects, *Saline water irrigation, *Plant physiology, *Salt tolerance, *Legumes, *Sodium chloride, *Sodium sulfate, *Soli-water-plant relationships, *Salinity, *Chickpeas, Anions, Plant growth, Soil chemistry, Survival, Crop production.

Survival, Crop production.

To assess the potential for developing a salt resistant cultivar of chickpea, 160 genotypes were screened for percent survival after nine weeks in greenhouse solution cultures with NaCl or Na2SO4. All plants grew well in the sulfate treatment, but only one cultivar survived the chloride treatment. Salt damage appeared and developed slowly. Salt composition affected shoot weight less than salt level or cultivar did. Shoot dry weight was only slightly less in chloride treatments than in isoosmotic sulfate, and for the least sensitive cultivar this held only at the highest salt level. Further, sensitivity to sulfate and to chloride was equal when sodium concentrations in shoots were equal, regardless of anion compositions of media. Shoot Na concentration was a useful negative indicator of growth under salt stress regardless of cultivar, and may be a useful tolerance indicator also for other species that neither accumulate nor efficiently exclude Na. (Author's abstract)

RESPONSE OF SELECTED SALT-TOLERANT AND NORMAL LINES OF FOUR GRASS SPE-CIES TO NACL IN SAND CULTURE, Liverpool Univ. (England). Dept. of Botany. For primary bibliographic entry see Field 2I. W87-05006

RESPONSE TO NACL AND IONIC CONTENT OF SELECTED SALT-TOLERANT AND NORMAL LINES OF THREE LEGUME FORACE SPECIES IN SAND CULTURE, Liverpool Univ. (England). Dept. of Botany. For primary bibliographic entry see Field 21. W87-05007

3D. Conservation In Domestic and Municipal Use

POLICY RELEVANCE IN STUDIES OF URBAN RESIDENTIAL WATER DEMAND, Arizona Univ., Tucson. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 6D. W87-04939

3F. Conservation In Agriculture

AGRICULTURAL WATER DEMAND IN NORTHEAST LOUISIANA, 1982-2000, Louisiana State Univ., Baton Rouge. Dept. of Agricultural Economics and Agribusiness. For primary bibliographic entry see Field 6D. W87-04367

COMPARING SPRINKLER IRRIGATION AND FLOOD IRRIGATION FOR RICE, Louisiana Agricultural Experiment Station, St. Joseph. Northeast Research Station. M. P. Westcott, and K. W. Vines. Louisiana Agriculture, Vol. 30, No. 1, p 20-22, Autumn 1986. 6 tab.

Descriptors: *Flood irrigation, *Rice, *Sprinkler irrigation, *Water use, *Irrigation effects, *Crop yield, *Plant growth, Louistana, Cost analysis, Comparison studies.

Sprinkler irrigation was compared to flood irrigation on a Sharkey clay in northeast Louisiana using adapted rice varieties. Disease levels, plant height, heading and lodging, dry matter production, and crop yield were determined. Grain yields with sprinkler irrigation in 1983 averaged 62% of those with flood irrigation and 75% in 1984. Sprinkler irrigation resulted in shorter plants and slightly

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F-Conservation In Agriculture

delayed heading in comparison with flood irriga-tion. Sheath blight infection was greatly stimulated by sprinkler irrigation in 1983; the infection rate was reduced substantially in 1984 by employment of benlate. Problems identified in sprinkler irriga-tion of rice were: increased problem of disease control and decreased yield when sheath blight was controlled chemically. Although water use probably was reduced by one-third to one-half with sprinkler irrigation, the savings thus generat-ed probably would not compensate for a yield reduction of 25-38%. (Rochester-PTT)

EFFECT OF FOLIAR APPLICATION OF FULVIC ACID ON WATER USE, NUTRIENT UPTAKE AND YIELD IN WHEAT, Henan Research Inst. of Biology, Zhen-ZZhou (China).

nary bibliographic entry see Field 2D.

WATER USE EFFICIENCIES IN RELATION

TO SUGARCANE YIELDS,
Booker Agricultural International Ltd., London
(England). For primary bibliographic entry see Field 2D. W87-04576

IRRIGATION SCHEDULING AND WATER-MELON YIELD MODEL FOR THE JORDAN

Descriptors: *Water use efficiency, *Irrigation efficiency, *Irrigation practices, *Jordan, *Watermelon, *Model testing, *Model studies, Mathematical equations, Trickle irrigation, Mulching, Field tests, Irrigation requirements, Soil moisture, Calibration

A crop yield and soil water management simulation model developed at Utah State University was
modified, calibrated and tested using local weather
data and field results from a trickle irrigation experiment with different mulching on watermelon
at the University of Jordan Research Station. Simulated irrigation schedules were applied with some
of the four options provided by the model. A
water yield index (WYI) to select the most efficient schedule based on yield and water use efficient schedule based on yield and water use efficiency was determined. WYI ranged from 27 to 87.
The field schedule had a WYI of 62, but the model
provided a much better schedule. This schedule
required 17 irrigations of 2.0 centimeters per irrigation with a total water supply of 44.1 centimeters
and an irrigation season starting on April 7 to give
a yield equivalent to the potential yield. The best
field schedule under transparent mulch required 14
irrigations to provide 45.9 centimeters (including
rainfall and soil moisture change) with the season
starting on April 28 to result in optimal yield.
Potential yield can be achieved by using the same
amounts of total water supply but with a different
schedule. The model has provided some better
schedules that can be tested in the field at lower
costs before final recommendations are made. (Author's abstract) thor's abstract) W87-04852

RYEGRASS ESTABLISHMENT AND YIELD IN RELATION TO PESTICIDE TREATMENT, IR-RIGATION AND FERTILISER LEVEL, Rothamsted Experimental Station, Harpenden (England). A. M. Spaull, R. O. Clements, M. S. Ridout, and P. G. Mewton.

Annals of Applied Biology AABIAV, Vol. 109, No. 2, p 353-363, October 1986. 1 fig, 9 tab, 22 ref.

Descriptors: *Ryegrass, *Nutrients, *Irrigation effects, *Pesticides, *Fertilization, Fungicides, Nematicides, Molluscicides, Crop yield.

The effects of irrigation, four fertilizer rates, fungicide, insecticide and molluscicide and nematicide

treatment were tested on an Italian ryegrass sward in a multi-factorial experiment that allowed treat-ment interactions to be examined. Pests and fungal disease were monitored for two years. No grass-land insect pests or slugs were found in the seed-bed, but there were an estimated 17,300 plant parabed, but there were an estimated 17,300 plant parasitic nematodes per liter of soil. Yields were increased most by irrigation in the first year, and there were large yield responses to fertilizer. Responses to pesticide application were relatively small, but there were significant first year yield responses to nematicide and insecticide and molluscicide treatments. Yields in the second year were affected more by increased fertilizer use than by irrigation. Increases after pesticide use were similar virtuation. Increases after pesticide use were similar circuit treatments. Tietos in the second year were affected more by increased fertilizer use than by irrigation. Increases after pesticide use were similar to the previous year, and there was a small but significant yield gain over untreated plots at the second harvest from those treated with fungicide. Interactions between main factors occurred both years affecting yields and nematode abundance. Nematode numbers were decreased in both years where the larger fertilizer applications had been made. In the first year, these differences were only apparent on irrigated plots. In this trial, irrigation had the greatest effect on yields of spring-sown ryegrass during its establishment year. Increasing fertilizer rates had a greater effect the following year. Fungi had little effect on ryegrass yields. Nematodes were more important pests than insects during establishment, but insects were more important subsequently. (Author's abstract)

EFFECT OF HYDROPHILIC POLYMER ON MEDIA WATER RETENTION AND NUTRI-ENT AVAILABILITY TO LIGUSTRUM LUCI-DUM,

DUM, Clemson Univ., SC. Dept. of Horticulture. K. C. Taylor, and R. G. Halfacre. Hortscience HJHSAR, Vol. 21, No. 5, p 1159-1161, October 1986. 3 fig, 2 tab, 11 ref.

Descriptors: *Soil amendments, *Fertilizers, *Polymers, *Water retention, *Nutrients, *Ligustrum, *Growth media, *Plant growth, Nitrogen, Potassium, Calcium, Magnesium, Hydrogen ion concentration. Fertilization

Ligustrum ludicum grown in hydrophilic polymeramended medium required irrigation less frequently than plants in nonamended medium. Plants contained higher levels of N and K and lower levels of Ca, Mg and other divalent cations when grown in polymer-amended medium as compared to con-trols. Polymer was associated with maintenance of r pH. With an osmocote rate increase from 15 to 45 grams, a polymer-fertilizer interaction was observed. Dry weights of polymer-treated plants decreased and controls increased with increasing fertility. (Author's abstract) W87-04858

EFFECTS OF ANTITRANSPIRANTS ON STO-MATAL OPENING AND THE PROLINE AND RELATIVE WATER CONTENTS IN THE

RELATIVE TOMATO, Indian Inst. of Horticultural Research, Bangalore. Div. of Plant Physiology and Biochemistry.

N. K. Srinivasa Rao.

The Journal of Horticultural Science JHSCA8, Vol. 61, No. 3, p 369-372, 1986. 3 tab, 14 ref.

Descriptors: *Evapotranspiration, *Antitranspirants, *Stomata, *Tomatoes, *Water retention, *Plant physiology, *Plant water potential, Phenyl mercuric acetate, Hydroxyquinoline sulfate, Kaolinite, Plant tissues, Plant physiology, Plant water potential, Proline.

The effects of three antitranspirants, phenyl mercuric acetate (PMA), 8-hydroxyquinoline sulfate (8-HQ) and kaolinite on stomatal opening, proline content and relative water content (RWC) of four tomato cultivars were examined. Some 20-33% of stomata were closed in the different cultivars. There were significant differences in cultivar response and the reduction in stomatal aperture varied from 32 to 37% in the cultivars. PMA was to most effective in reducing stomatal aperture Significant differences were observed between the cultivars both in proline content and RWC as

affected by antitranspirants. Arka Vikas had sig-nificantly higher proline content and RWC. PMA increased both proline and RWC. In tomato culti-vars treated with antitranspirants, there appeared to be a better maintenance of high RWC values with a higher degree of stomatal control. (Author's

EFFECT OF DROUGHT AND IRRIGATION ON THE FATE OF NITROGEN APPLIED TO CUT PERMANENT GRASS SWARDS IN LYSIMETERS: NITROGEN BALANCE SHEET AND THE EFFECT OF SWARD DESTRUCTION AND PLOUGHING ON NITROGEN MINER-ALIZATION.

Agricultural Research Council, Wantage (England). Letcombe Lab. For primary bibliographic entry see Field 5B. W87-04863

EFFECT OF THE STRUCTURAL STATE OF THE PLOUGHED LAYER ON ITS WATER RE-TENTION (EFFET DE L'ETAT STRUCTURAL D'UNE COUCHE LABOUREE SUR SA RETEN-TION EN EAU), Institut National de la Recherche Agronomique,

For primary bibliographic entry see Field 2G. W87-04864

CONTRIBUTION TO THE STUDY OF BIOCHEMICAL MECHANISMS OF RESISTANCE
TO WATER STRESS: PROLINE ACCUMULATION DURING THE VEGETATIVE CYCLE OF
BREAD WHEAT (TRITICUM AESTIVUM L.)
AND DURIM WHEAT (TRITICUM DURUM
DESF.) (CONTRIBUTION A L'ETUDE DE LA
RESISTANCE A LA SECHERESSE CHEZ LE
BLE TENDRE (TRITICUM AESTIVUM L.) ET
CHEZ LE BLE DUR (TRITICUM DURUM
DESF.): ETUDE DE LACCUMULATION DE LA
PROLINE AU COURS DE CYCLE DE DEVELOPPEMBENT). LOPPEMENT), Ecole Nationale Superieure Agronomique de

Montpellier (France).
For primary bibliographic entry see Field 2D.
W87-04865

DIURNAL PATTERNS OF PHOTOSYNTHE-SIS, EVAPOTRANSPIRATION AND WATER USE EFFICIENCY IN MUSTARD AT DIFFER-ENT GROWTH PHASES UNDER FIELD CON-DITIONS.

Haryana Agricultural Univ., Hissar (India). Na-tional Agricultural Research Project. For primary bibliographic entry see Field 2D. W87-04862

DROUGHT AND TROPICAL PASTURE MAN-

AGEMENT,
Maiduguri Univ. (Nigeria). Dept. of Crop Science.
P. O. Ugherughe.

Agronomy and Crop Science Journal of Agronomy and Crop Science ZAPFAR, Vol. 157, No. 1, p 13-23, July 1986. 1 tab, 49 ref.

Descriptors: *Drought effects, *Pasture management, *Tropical regions, *Plant populations, *Productivity, *Species diversity, Plant growth, Grasses, Legumes, Water deficit, Nutrients, Light penetration, Grazing, Weed control, Forages, Water demand, Agriculture.

One of the most difficult features of managing pastures in arid and semi-arid regions is the variability in production from year to year. An understanding of the factors controlling plant interrelations is needed to establish secure bases for management recommendations. Several species with agement recommendations. Several species with different time periods of growth may contribute to a greater total forage production than just one species. Different grasses and legumes have peak demands for water at different times and may also vary in the use depth of the soil. Each kind of plant has slightly different requirements either in mois-ture, light or nutrients, so that two or more forage cies are usually better than only one. Conv

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ing pasture to animal products depends on the amount, quality and seasonality of the pasture species, the proportion of pasture species actually consumed by the animal and the efficiency of conversion of consumed fodder within the animal. For increased agricultural productivity and efficient resource use in drought-prone areas, pasture agronomists should pay attention to those characteristics most needing improvement in the suite of available tropical grasses and legumes that are presented in this discussion. (Michael-PTT)

INFLUENCE OF SOIL WATER REGIMES ON VA MYCORRHIZA, IV, EFFECT ON ROOT GROWTH AND WATER RELATIONS OF SOR-

GHUM BICOLOR,
Goettingen Univ. (Germany, F.R.). Inst. fuer
Pflanzenbau. For primary bibliographic entry see Field 2I. W87-04870

PHYSIOLOGICAL BASIS OF IRRIGATION SCHEDULING FOR SEED PRODUCTION IN EGYPTIAN CLOVER SYN, BERSEEM (TRIFOLIUM ALEXANDRINUM L.) CROP, Indian Grassland and Fodder Research Inst.

N. C. Sinha, and R. P. Singh.

Journal of Agronomy and Crop Science
ZAPFAR, Vol. 156, No. 4, p 246-252, May 1986. 3
tab, 17 ref.

Descriptors: *Irrigation efficiency, *Scheduling, *Water stress, *Plant physiology, *Seeds, *Clovers, Field tests, Crop yield, Proline, Plant growth, Reproduction, Sugars, Berseem.

A field experiment was conducted to determine the critical physiological stages of irrigation scheduling that would promote better growth, physiological efficiency and seed yield potential of berseem. Eight irrigation treatments were applied comprised of four treatments at three irrigation schedules and one treatment at five irrigation schedules at various physiological schedules such as regeneration, flower initiation, full bloom, seed initiation, and the advanced seed development stage. Withholding irrigation either at regeneration or full bloom stage developed potential water stress in plants as indirigation either at regeneration or full bloom stage developed potential water stress in plants as indicated by high proline content at three irrigation treatments. Water stress also disturbed the formation of carotene, synthesis of water soluble sugar and translocation of water soluble sugar towards reproductive organs during the grain development stage. These stresses adversely affected plant growth and flowering behavior. Irrigation at the seed initiation stage increased seed yield. Continuous irrigation did not appear to be useful. It is concluded that irrigation at regeneration, full bloom and seed initiation is essential for obtaining potential seed yield of berseem. (Author's abstract) W87-04878

EFFECTS OF TEMPERATURE AND PRIOR FLOODING ON INTENSITY AND SORPTION OF PHOSPHORUS IN SOIL: I. EFFECTS ON THE KINETICS OF SOLUBLE P IN SOIL, California Univ., Davis. Dept. of Agronomy and Range Science.

For primary bibliographic entry see Field 2G. W87-04892

EFFECTS OF TEMPERATURE AND PRIOR FLOODING ON INTENSITY AND SORPTION OF PHOSPHORUS IN SOIL: II. EFFECTS ON

P SORPTION, California Univ., Davis. Dept. of Agronomy and Range Science. For primary bibliographic entry see Field 2G. W87-04893

POTASSIUM AVAILABILITY IN RELATION TO SOIL MOISTURE: I. EFFECT OF SOIL MOISTURE ON POTASSIUM DIFFUSION, ROOT GROWTH AND POTASSIUM UPTAKE OF ONION PLANTS,

Goettingen Univ. (Germany, F.R.). Inst. fuer Agri-kulturchemie. For primary bibliographic entry see Field 2G. W87-04894

POTASSIUM AVAILABILITY IN RELATION TO SOIL MOISTURE: II. CALCULATIONS BY MEANS OF A MATHEMATICAL SIMULATION MODEL, Goettingen Univ. (Germany, F.R.). Inst. fuer Agriculturchemie.

For primary bibliographic entry see Field 2G. W87-04895

RELATIONSHIPS BETWEEN WATER STRESS AND ULTRASOUND EMISSION IN APPLE (MALUS X DOMESTICA BORKH.), East Malling Research Station, Maidstone (England), Plant Physiology Dept. For primary bibliographic entry see Field 2I. W87-04899

EFFECTS OF OSMOTIC POTENTIAL IN NUTRIENT SOLUTION ON DIURNAL GROWTH OF TOMATO FRUIT,

shouse Crops Research Inst., Littlehampton (England). For primary bibliographic entry see Field 2I. W87-04900

EFFECT OF SUBSOILING AND IRRIGATION ON POTATO PRODUCTION, Department of Scientific and Industrial Research, Lower Hutt (New Zealand).

Soil and Tillage Research SOTRD5, Vol. 7, No. 4, p 315-325, August 1986. 5 fig, 1 tab, 20 ref, append.

Descriptors: *Tillage effects, *Subsoiling, *Irriga-tion, *Potatoes, *Crop production, *Root develop-ment, *Crop yield, Agronomy, Fertilizers, Roots, Soil physical properties, Drought, Soil texture, Re-gression analysis, Porosity, Soil porosity.

Thin tillage pans restrict water movement and potato root penetration in fine-textured soils of the Columbia Basin. Deep chiseling beneath potato rows, with simultaneous deep incorporation of fercolumbia Basin. Deep chiseling beneath potato rows, with simultaneous deep incorporation of fertilizer, was used to break-up the pans, enabling deeper root development. The effects of subsoiling on soil physical conditions and on potato production were examined under varying rates of irrigation. Deep tillage decreased soil strengths and bulk densities and increased porosity to depths of 10-16 cm below the pans. These improved subsoil physical conditions resulted in deeper root penetration, although the additional rooting only amounted to a small increase to the total root system. Regression analysis demonstrated that subsoiling significantly increased potato yields under very droughty conditions, but had no significant effects at intermediate (near optimum) levels of water application. Potato quality was generally unaffected by deep tillage. These results indicate that appropriate irrigation management can be used to overcome problems of restricted root penetration and impeded water movement in potatoes caused by tillage pans. (Author's abstract)

ORIFICE PLATES FOR FURROW FLOW MEASUREMENT: PART 1 - CALIBRATION, Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center. T. J. Trout.

Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 103-106, 111, January-February 1986. 3 fig, 3 tab, 10 ref.

Descriptors: *Orifice plates, *Flow measurement, *Measuring instruments, *Furrow flow, *Furrow irrigation, *Irrigation, *Calibrations, Infiltration rates, Discharge, Head loss, Submerged flow,

Inflow-outflow measurement of furrow infiltration rates is perferable because the measurement is made under near normal operational conditions.

However, the infiltration determination is sensitive to flow measurement errors, especially if the measurement is made over short furrow sections in which less than half the inflow is infiltrated. Accurate flow measurement is thus critical. Orifices, due to their discharge sensitivity to head, are nees, due to their discharge sensitivity to head, are potentially the most accurate open channel flow measurement device and consequently, the best device for determining furrow infiltration rates by the inflow-outflow method. Laboratory calibration the inflow-outflow method. Laboratory calibration determined that orifices under submerged flow conditions are insensitive to boundaries as close as one-half diameter from an edge, allowing practical field use of multi-holed orifice plates in furrows. Submerged flow discharge coefficient for squaredged orifices with the plate thickness less than one-third of the diameter is 0.625. Free flow coefficients vary both with orifice size and head. (See also W87-04920) (Alexander-PTT)

ORIFICE PLATES FOR FURROW FLOW MEASUREMENT: PART II - DESIGN AND

MEAUREMENT FOR A STREET OF THE TO USE,
Agricultural Research Service, Kimberly, ID.
Snake River Conservation Research Center. T. J. Trout.

Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 107-111, January-February 1986. 5 fig, 7 ref.

Descriptors: *Orifice plates, *Measuring instruments, *Flow measurement, *Furrow flow, L'escriptors: "Ornice piates, "Measuring instru-ments, "Flow measurement, "Furrow flow, "Furrow irrigation, "Irrigation, "Design standards, Head loss, Infiltration, Submerged flow, Design equations, Field tests.

Orifice plates are potentially accurate flow measurement devices due to their sensitivity to head. A companion paper determined, through laboratory calibration, that (a) flow through small circular orifices was not affected by boundaries, caused by the furrow perimeter, the water surface, or adjacent orifices, within one half orifice diameter of the orifice edge; (b) square-edged furrow orifice sub-merged flow discharged coefficient is 0.625; (c) merged now discnarged coefficient is 0.6.2; (c) free flow coefficients vary with the orifice size and head and thus free flow use is not recommended; (d) the discharge coefficients are not affected by hole edge thickness up to a thickness/diameter ratio of 1/3; and (e) orifice discharge coefficients are sensitive to rounding of the upstream edge. are sensitive to rounding of the upstream edge.
These laboratory results are utilized to develop furrow orifice plate designs and determine measurement accuracies and limitations under field conditions. Flow measurement accuracy decreases ditions. Flow measurement accuracy decreases with head loss. Orifice head loss will increase upstream infiltration. Thus, the head loss range must be constrained to maintain measurement acmust be constrained to maintain measurement ac-curacy. Design equations are developed for 3-hole orifice plates which give a 23:1 flow range with a 5:1 head loss range. A portable differential point gauge can measure submerged flow head loss to the nearest millimeter. (See also W87-04919) (Alexer-PTT) W87-04920

MICROCATCHMENT WATER HARVESTING FOR RAISING JUJUBE ORCHARDS IN AN ARID CLIMATE, Indian Council of Agricultural Research, New

Delhi For primary bibliographic entry see Field 3B. W87-04921

PARAMETER VALUE PREDICTION FOR HOLTAN'S INFILTRATION EQUATION, Illinois Univ. at Urbana-Champaign. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 2G.
W87-04929

AUTOMATED SINGLE-PIPE IRRIGATION

Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center.

A. S. Humpherys.
Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 185-193, January-February 1986. 6 fig. 1 tab, 7 ref, append.

Field 3—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3F-Conservation In Agriculture

Descriptors: *Automation, *Irrigation systems, *Water conveyance, *Hydraulic machinery, Head loss, Pipelines, Costs, Distribution, Valves, Single-pipe irrigation systems.

pspe irrigation systems.

Gated irrigation pipe can be used for both water conveyance and water distribution. When a single gated pipeline is used for a number of irrigation sets, one group of gates must be closed and another group opened at each irrigation set change. This requires considerable labor which can be reduced by automating the system. An automated single-pipe system was developed for both water conveyance and distribution to the field. The pipe has a flexible tube liner inside and is equipped with automated diverter valves. The valves direct water either through the flexible tube for conveyance to downstream pipeline sections or to the outside of the tube for distribution to the field through the pipe gates. The system is well suited for automating multiple-set gated pipe systems for both conventional and surge flow irrigation. Head loss coefficients were determined for the valves and the pipeline for both the conveyance and distribution modes. Field installation procedures are described. The cost of the single-pipe system is about 60% of that for an automated double pipe system. (Alexander-PTT) W87-04931

WATER MANAGEMENT EFFECTS ON N-USE BY CORN AND SUGARBEETS,

Agricultural Research Service, Mandan, Northern Great Plains Research Center. G. A. Reichman, E. J. Doering, and L. C. Benz. Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 198-202, January-February 1986. 1 fig, 5 tab,

Descriptors: *Water management, *Nitrogen use, *Corn, *Sugarbeets, *Irrigation effects, *Fertilizers, *Crop yield, Plant growth, Irrigation, Nutrients, Field tests, Forages, Soil properties, Water table depth, Soil types.

Soils of the Northern Great Plains generally have a high level of organic N that is readily mineralized. Often under these conditions, more N is removed high level of organic N that is readily mineralized. Often under these conditions, more N is removed by the crop than is applied as fertilizer. Total N removed each year by all crops in North Dakota from 1945 to 1971 greatly exceeded the fertilizer N added. A 3-year field study was conducted to determine the effects of surface irrigation, depth to water table and rate of N-fertilization on dry-matter forage yields, N-uptake of crops, and soil-N levels. Corn (Zea mays L.) and sugarbeets (Beta vulgaris L.) were grown on a complex of Aquic Haploboroll, Typic Calciaquoll, and Typic Haplaquoll soils with average water-table depths of 147, 203, and 229 cm deep during the growing season of May 15-September 30. All combinations of surface irrigation and N level occurred with each water table. Half of the plots were surface (sprinkler) irrigated and half were not. Available N (soil plus fertilizer) levels were established each spring at 56, 112, or 224 kg N/ha. The soil supplied considerable N because the harvested corn forage and sugarbeet roots contained more N than was applied during the three years. Yields, N-uptake and the proportion of available N taken up by plants were the greatest at the shallowest water table. Surface irrigation of soils with the 203 and 229 cm water tables increased yields and N-uptake. Yields and N-uptake were increased by N-fertilization. The fraction of available N taken up by Jerops was greatest at the 112 kg N/ha rate. The data from this study suggest that both N and water applications need to be carefully chosen to optimize profits when a nonsaline watertable is less than 203 cm below the soil surface. (Alexander-PTT)

EFFICIENT IRRIGATION TIMING METHODS

FOR CORN PRODUCTION, North Dakota State Univ., Fargo. Dept. of Agricultural Engineering.

E. C. Stegman.

Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 203-210, January-February 1986. 6 fig, 6 tab,

Descriptors: *Irrigation scheduling, *Corn, *Productivity, *Irrigation effects, *Evapotranspiration, *Plant growth, *Crop yield, Root zone, Water stress, Field tests, Arid climates, Leaves, Water potential, Seasonal variation, Climates, Soil types,

Water use efficiency.

Irrigation timing methods were tested at two field sites (sub-humid climate) with respective root zone available water holding capacities of 114 and 170 mm to 1.2 m profile depth. The objective was to achieve high yields with reduced irrigation relative to full irrigation regimes. The selected timing methods were expressed in the form of allowable reductions in root zone available water by growth stage, deficit evapotranspirations (ET) replacement as determined by reduced system pumping capacity, threshold leaf water potentials, or threshold crop water stress indices. These treatments were compared to a reference treatment that was irrigated (at 1.0 ET replacement) when root zone available water level fell to the 60-70% (remaining) range. Maximum yields were consistently proble water level fell to the 60-70% (remaining) range. Maximum yields were consistently produced by the reference treatment. Curvilinear relatives seasonal irrigation data. These relationships were fitted to the relative yield vs. relative seasonal irrigation data. These relationships indicate that about 95% of maximum yield can be achieved in this climate with any of the tested methods with reductions in seasonal irrigation amount (relative to full irrigation) averaging 23 and 30% for the coarse and medium textured soils, respectively. Efficiency expressed as yield per unit irrigation was increased from 2.7 (reference treatment) to an average of 3.4 kg/cu m for the text methods on the coarse textured soil. These values improved from 3.8 to 5.5 kg/cu m on the medium textured soil. Water use efficiencies were very uniform across all treatments (in seasons not affected by corn borer or frost) at both sites, averaging 2.2 kg/cu m. (Author's abstract)

TEMPERATURE EFFECTS ON DRIP LINE HYDRAULICS,

HYDRAULICS, Chinese Academy of Agricultural Science, Henan. Research Inst. of Farm Irrigation. G.-F. Peng, L.-P. Wu, and C. J. Phene. Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 211-215, January-February 1986. 4 fig, 8 ref.

Descriptors: *Temperature effects, *Drip lines, *Irrigation systems, *Mathematical equations, *Hydraulics, *Drip irrigation, Friction loss, Energy, Pipelines, Irrigation.

Drip irrigation lines installed on the soil surface are Drip irrigation lines installed on the soil surface are subject to temperature changes by convection and radiation due to ambient temperature and direct sunshine respectively. This change of temperature of drip lines will affect the water temperature in the line. The water temperature variation along the line will affect the hydraulic performance of both emitter and drip irrigation lines. Several theoretical equations were derived to describe the effect of temperature changes on the hydraulics of drip irrigation lateral lines. When the total discharge in a lateral line remains constant the temperature irrigation lateral lines. When the total discharge in a lateral line remains constant the temperature effect on total friction drop at the end of the line can reach as much as + or - 10% for a temperature difference from - 90 C to + 50 C compared with a base condition, T = 20 C and no temperature difference along the length. The temperature effect on the shape of energy gradient was insignificant. A temperature difference ranging from + or - 20 C to + or - 50 C along the line causes approximately 1 to 2% (of the total friction delta H sub L) difference at the middle section of the lateral line. (Alexander-PTT)

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

SEDIMENT CONTROL BY SUBMERGED

Iowa Univ., Iowa City. Dept. of Civil Engineer-For primary bibliographic entry see Field 2J. W87-04391

SPATIAL AND TEMPORAL CHARACTERISTICS OF HIGH-INTENSIVE RAINFALL IN NORTHERN TUNISIA, Lund Univ. (Sweden). Dept. of Water Resources

Engineering.
For primary bibliographic entry see Field 2B.
W87-04400

PAPER DAM: THE ROLE OF THE INTERNA-TIONAL JOINT COMMISSION IN THE RESO-LUTION OF THE SKAGIT RIVER-HIGH ROSS DAM CONTROVERSY, Saint Lawrence Univ., Canton, NY. For primary bibliographic entry see Field 6E. W87-04816

BATTLING A RISING GREAT SALT LAKE,

Engineering News-Record ENREAU, Vol. 217, No. 20, p 25, 28-29, November 13, 1986.

Descriptors: *Water level fluctuations, *Lakes, *Drainage engineering, *Great Salt Lake, *Pumping, *Diversion, Diversion channels, Lake evaporation. Lake shor

The Great Salt Lake has risen 12 feet in the past four years and caused an estimated \$300 million in damage. The most ambitious of several measures taken to protect the surrounding area involves pumping water out of the lake into a large pond. The project includes a pumping station to channel water to three large pumps that will move up to 3,300 cubic feet of water per second. The water will move through an outlet canal to a new pond that will allow much more evaporation to occur. The rate of the lake's rise may outpace the capacity of the pumps to divert water to the new pond which is located in the middle of Hill Air Force Base, home of a test bombing range. Another project involves diking and raising a long railroad causeway across the lake. Problems and costs associated with these protective measures and alternative diversion approaches are also discussed. (Mi-M97.04837 chael-PTT) W87-04837

SOVIETS SHELVE PLAN ON DIVERTING RIVERS IN ARCTIC REGIONS,

P. R. Ryan. Oceanus, Vol. 29, No. 1, p 78-80, Spring 1986. 1

Descriptors: *Soviet Union, *River diversion, *Arctic Ocean, *Water management, *River flow, Siberia, Weather modification, Weather patterns, Climatology, Water demand.

Climatology, Water demand.

A Soviet plan to divert water from rivers in European Russia that flow into the Arctic Ocean was postponed following shelving of a more ambitious plan to divert water from Siberia to Central Asia. Critics of the projects argued that water diversions from rivers flowing into the Arctic Ocean might change weather patterns not only in the Soviet Union but around the world. Critics also held that the projects would inundate some ancient Russian towns, and affect fishing, rainfall patterns and river navingation. The primary purpose of the first phase European diversion was to enhance water supplies in the drainage basins of the Caspian and Azov Seas where resources are believed inadequate to meet the needs of irrigation, hydroelectricity, transportation and fishery requirements of the future. The Siberian project would take 27.2 cubic kilometers of water annually from the River Ob and its tributary and send it southward along a transfer route of 2,544 kilometers. Soviet water mangement specialists viewed this project as a long term solusts viewed this project as a long term soluspecialists viewed this project as a long term some tion for a worsening water supply problem in Kazakhstan and Central Asia. Most researchers are confident that the smaller European diversion project would have little effect on ocean circula-tion or sea ice distribution. They are less sure about

WATER QUANTITY MANAGEMENT AND CONTROL-Field 4

Groundwater Management—Group 4B

the larger Siberian diversion project and point out the limitations of modeling studies of ocean circu-lation and sea ice distribution undertaken in the 1970s. More research is needed on this subject before climates are altered by large-scale water transfer projects. (Michael-PTT) W87-04844

EFFECT OF LOCAL GROUND SLOPE ON THE PERFORMANCE OF TILE DRAINS IN A CLAY SOIL

SOII., London Univ. (England). Dept. of Geography. R. J. Parkinson, and I. Reid. Journal of Agricultural Engineering Research JAERA2, Vol. 34, No. 2, p 123-132, June 1986. 7 fig, 1 tab, 21 ref.

Descriptors: *Hydrographs, *Natural slope, *Tile drains, *Clays, *Drainage engineering, *Drainage patterns, Seasonal variation, Drainage water, Drainage effects, Rainfall, Cracks, Soil properties.

The hydrograph response of tile drains laid in a heavy clay soil on a convex slope is described. Drainage efficiency was inversely related to local ground slope. Peak drain discharge was also inversely related to ground slope, peak drain discharge was also inversely related to ground slope, particularly during winter when water contents were high, but the drain hydrograph showed a quicker response to rainfall on steeper slopes. The time of concentration was reduced by 1.5 hours for every 1% increase in ground slope. The differential behavior of tile laterals indicated the pathways taken by rainwater once it entered the soil. Desciation cracks were used to bypass the topsoil in autumn, but once the soil was swollen by autumn rain, plow-layer interflow became a more significant route for drainage. Water passed to the drainage installation down the looser soil overlying the tile laterals or down persistent cracks left by the leg of the mole plow after lateral flow within the topsoil. The catchment of an individual tile drain was shown to be inversely related to local ground slope, at least in winter. This is due to the drainage divide shifting upslope in response to increasing slope gradient. In convex situations this results in a loss of contributing area on the downslope side of the lateral that was not compensated for by commensurate gains on the upslope side. Short-term drainage efficiency fell from 82 to 45% as slope increased from 3.6 to 5.1%. Since the objective of a drainage installation is rapid evacuation of rainwater, this unexpected effect of local ground slope in reducing drain efficiency has considerable significance for the design of underdrainage schemes in undulating topography. (Author's abstract) W87-04859 The hydrograph response of tile drains laid in a heavy clay soil on a convex slope is described.

DESIGN OF NATIONAL, REAL-TIME WARN-ING SYSTEMS WITH CAPABILITY FOR SITE-SPECIFIC, FLASH-FLOOD FORECASTS, Iowa Univ., Iowa City. Dept. of Civil Engineer-

For primary bibliographic entry see Field 7A.

APPLIED CARRYING CAPACITY CONCEPT FOR INTEGRATING STORMWATER MANAGEMENT AND LAND USE PLANNING, A CASE STUDY: THE KUANTU PLAIN OF TAIPEI, TAIWAN, National Chunghsing Univ., Taichung (Taiwan). Graduate Inst. of Urban Planning. S.-L. Huang, and M.-C. Huang. ECMODT, Vol. 33, No. 1, p 35-58, September 1986. 10 fig, 1 tab, 18 ref.

Descriptors: *Land management, *Storm water, *Surface water management, *Model studies, *Rainfall-runoff relationships, *Storm runoff, *Land development, *Hydrologic aspects, *Mathematical models, Drainage, Soil water, Rainstorms, Soil Cover Complex Method, Taiwan, Mathemati-Soil Cover Comple cal studies, Runoff.

The carrying capacity of land resources in terms of hydrologic consequences of land development is the basis of a proposed method for integrating the land planning process with stormwater manage-

ment. Concepts of natural drainage such as soil moisture storage capacity for rainwater infiltration, and vegetated depressed surface for collecting storm runoff are used as criteria of performance control for ensuring balance between land devel-opment and hydrologic processes. A stormwater management model is developed which includes a repairs and nyturologic processes. A stormwater management model is developed which includes a land program, hydrologic process, and stormwater management techniques to simulate the hydrologic effects of various land development programs, and to estimate their land use performance standards. The model uses the Soil Cover Complex Method developed by the U.S. Soil Conservation Service to compute the hydrologic effects. The land use performance standards incorporated in this research include: pervious areas required, swale area required, and average depth of retention pond. The land characteristics of Kuantu Plain, Taipei, Taiwan are used as a case study to estimate land use performance standards of natural drainage. The model outputs provide useful guidance to help land use planners utilize land resources more efficiently. (Author's abstract) W87-05003

4B. Groundwater Management

HYDROGEOLOGICAL PARAMETER ESTIMA-TION FROM PUMP TESTS ON A LARGE DI-AMETER WELL, National Geophysical Research Inst., Hyderabad

For primary bibliographic entry see Field 2F. W87-04395

MOLE DRAINAGE OF A HALLSWORTH

SERIES SOII,
Ministry of Agriculture, Fisheries and Food, Cambridge (England). Field Drainage Experimental For primary bibliographic entry see Field 2G. W87-04572

RATIONAL FOR PERMEABLE BACKFILL PLACED OVER PIPE DRAINS,

Ministry of Agriculture, Fisheries and Food, Cambridge (England). Field Drainage Experimental For primary bibliographic entry see Field 2G. W87-04573

INFORMATION NEEDS FOR GROUNDWATER POLLUTION CONTROL, Case Western Reserve Univ., Cleveland, OH. Y. Y. Haimes. The Environmental Professional, Vol. 8, No. 3, p

190-198, 1986. 1 fig, 5 tab, 4 ref.

Descriptors: *Information retrieval, *Management planning, *Groundwater pollution, *Mathematical models, *Water quality control, Standards, Financing, Technology transfer, Public relations, Monitoring.

In an effort to understand the information needed for dealing with groundwater pollution (contamination) control, a hierarchy of objectives, modeling steps and aspects, is mapped out. Specific information needs are identified. In particular, four objectives for groundwater pollution control are set out: (1) detection and monitoring, (2) prevention, (3) abatement and containment, and (4) correction and restoration. Management of contaminated groundwater requires four steps: (1) identification, (2) quantification, (3) evaluation, and (4) management. And three aspectified: its causes, sources, and impacts. Lists for each level in the hierarchy are detailed in tables. The second part of the paper focuses on the information needed for management of (i.e., possible solutions to) the groundwater pollution problem. Eight categories are identified: public and decisionmakers' awareness; political will; the legal-regulatory mandate; organizational structure; financial and economic considerations; technology transfer; educating and training of personnel; and research and development. (Author's abstract)

W87-04811

PREPARATION OF PROFESSIONALS FOR GROUNDWATER PROTECTION, California Univ., Los Angeles.
For primary bibliographic entry see Field 9A.

LOCAL FINANCE AND POLICY FOR GROUNDWATER PROTECTION, Cornell Univ., Ithaca, NY. For primary bibliographic entry see Field 9D. W37-04813

FUNCTIONS AND ACTIVITIES OF GROUND-WATER PROTECTION: IMPLICATIONS FOR INSTITUTIONAL COORDINATION, Oklahoma Univ., Norman. Enviror Ground Water Inst. For primary bibliographic entry see Field 6E. W87-04814

EFFECTIVENESS AND EQUITY OF GROUND-WATER MANAGEMENT METHODS IN THE WESTERN UNITED STATES, Clark Univ., Worcester, MA.
For primary bibliographic entry see Field 6E.
W87-04815

EVAPORATION AND NON-TILE SEEPAGE DURING WATER TABLE DRAWDOWN, Agricultural Research Service, Temple, TX. J. G. Arnold, C. W. Boast, and W. D. Lembke. Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 151-156, January-February 1986. 3 fig, 8 tab, 12 ref.

Descriptors: *Evaporation, *Seepage, *Subsurface drainage, *Water table fluctuations, *Drawdown, *Soil properties, *Soil porosity, Estimating, Permeability coefficient, Ponding, Saturation, Water table, Soil types, Tile drains, Pan evaporation.

There is a lack of experience and drainage recommendations for clayey (heavy) soils because subsurface drainage has not been used extensively on these soils. The design and feasibility of subsurface drainage systems for heavy soils have not been satisfactorily resolved. In the 1960's and 1970's satisfactorily resolved. In the 1960's and 1970's contractors began installing subsurface drains in heavy soils at an increasing rate. However, the Soil Conservation Service did not have drainage recommendations for many of these heavy soils. A procedure was previously developed to determine drainable porosity, hydraulic conductivity, and tie spacing of heavy soils. A major factor affecting the accuracy of the procedure is the effect of evaporation and non-tile seepage. A technique was developed and field data were collected to validate or improve the existing evaporation estimate and to oped and field data were collected to validate or improve the existing evaporation estimate and to obtain initial estimates of non-tile seepage. In this study with the Zipp soil series, one plot was in agreement with the current evaporation estimate while the other plot was affected by surface ponding and incomplete saturation. Non-tile seepage rates for five of six cases examined, ranged from 0.2 to 3.7 mm/day depending on soil type and water table depth. (Alexander-PTT) W87-04925

GEOPHYSICAL MAPPING OF A BURIED BASALT/SEDIMENTARY INTERFACE, EAST-ERN SUDAN, Kuwait Univ., Safat. Dept. of Geology. For primary bibliographic entry see Field 2F. W87-05063

CHARACTERIZATION OF FRACTURE PER-MEABILITY WITH HIGH-RESOLUTION VER-TICAL FLOW MEASUREMENTS DURING BOREHOLE PUMPING,

Geological Survey, Denver, CO. Borehole Geo-physics Project. F. L. Paillet, A. E. Hess, C. H. Cheng, and E. Ground Water GRWAAP, Vol. 25, No. 1, p 28-40,

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 48-Groundwater Management

January-Pebruary 1987. 10 fig, 3 tab, 24 ref. NSF Grant EAR83-12945.

Descriptors: *Fracture permeability, *Pumping tests, *Aquifer testing, *Flow measurement, *Groundwater movement, *Borehole pumping, *Messuring instruments, Inflow, Outflow, Flow, Conduits, Flowmeters, Permeability, Pumping tests, Geologic fractures.

The distribution of fracture permeability in granitic rocks was investigated by measuring the distribution of vertical flow in boreholes during periods of steady pumping. Pumping tests were conducted at two sites chosen to provide examples of moderately fractured rocks near Mirror Lake, New Hampshire and intensely fractured rocks neat Oracle, Arizona. A sensitive heat-pulse flowmeter was need for accurate measurements of vertical flow as low as 0.2 liter per minute. Although boreholes were spaced at intervals ranging from 10 to 50 meters, acoustic televiewer logs showed little direct continuity of individual fractures from borehole to berehole in either the moderately fractured rocks or intensely fractured rocks. Results indicated that nearly all inflow and outflow to boreholes occurred by means of one or two discrete fractures ed that nearly all inflow and outflow to boreholes occurred by means of one or two discrete fractures in both cases. These fractures did not appear very different from other prominent fractures indicated on televiewer and resistivity logs for these boreholes. Hydraulic connections between boreholes apparently were composed of conduits formed by the most permeable portions of intersecting fractures. Most flow in the moderately fractured rocks occurred at isolated fractures at a depth of about 45 meters indicating a nearly horizontal zone of fracture permeability composed of orthogonal, steeply dipping fractures. Previous studies have identified a zone of horizontal permeability in the lower part of the boreholes in the intensely fractured rocks, but flowmeter tests indicated that flow also entered and exited individual boreholes by means of one or two steeply dipping fractures. ano entered and exteel univious porenotes by means of one or two steeply dipping fractures. These results indicate zones of fracture permeability in crystalline rocks are composed of irregular conduits that cannot be approximated by planar fractures of uniform aperture, and that the orientation of permeability zones may be unrelated to the tion of permeability zones may be unrelated to the orientation of individual fractures within those zones. (Author's abstract)

AIRBORNE GEOPHYSICAL EXPLORATION FOR GROUND WATER, Peterson, Grant and Watson Ltd., Toronto (Ontar-

For primary bibliographic entry see Field 7B. W87-05066

PUMPING TEST ANALYSIS IN LARGE DIAM-ETER WELLS WITH A SEEPAGE FACE BY KERNEL FUNCTION TECHNIQUE, Birmingham Univ. (England). Dept. of Civil Engi-

R. R. Rushton, and V. S. Singh. Ground Water GRWAAP, Vol. 25, No. 1, p 81-90, January-February 1987. 6 fig, 2 tab, 16 ref, 2

Descriptors: *Pumping tests, *Wells, *Kernel function technique, *Seepage faces, *Computer programs, Transmissivity, Aquifers, Water level, Storage, Recovery, Field tests, Seepage, Estimating.

Large diameter wells are of great importance in low transmissivity unconfined aquifers. They have the property that during the abstraction phase most of the water is taken from storage, but when the pump is switched off, water continues to flow from the aquifer to refill the well. In many cases more water is drawn from the aquifer during the recovery phase than during the pumping phase. A method of analyzing the pumping and recovery phases of large diameter wells based on a Kernel function method is presented. Consideration is given to the effect of the seepage face, which is the difference between the well-water level and the aquifer level on the well-grain for the ASIC, is provided. In the analysis of a representative field test, the importance of including the

seepage face is demonstrated; if the seepage face is ignored, both the tra~missivity and storage coefficient are underestimated. (Alexander-PTT)

INNOVATIVE MEANS OF DEALING WITH POTENTIAL SOURCES OF GROUND WATER CONTAMINATION. National Water Well Association, Worthington,

For primary bibliographic entry see Field 2F. W87-05071

RELATION OF GROUNDWATER QUANTITY AND QUALITY. International Association of Hydrological Sci-

For primary bibliographic entry see Field 2F. W87-05100

RESPONSES OF HYDROLOGICAL SYSTEMS TO CHANGES IN WATER QUANTITY AND

QUALITY, Institute for Soil Fertility, Groningen (Nether-lands).

P. A. C. Rasts.
IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the
XVIIIth General Assembly of the International
Union of Geodesy and Geophysics, Hamburg, FR
Germany, August, 1983. IAHS Publication No.
146, p 3-12, 1 fig. 22 ref.

Descriptors: *Hydrologic systems, *Water supply, *Water quality, *Hydrologic models, Model studies, Computer models, Groundwater recharge, Groundwater, Mathematical studies, Solutes, Mathematical equations, Flow profiles.

There is an abundance of models intended for the evaluation of a wide range of aspects of water quantity and quality. Computers can be instructed to deal with intricate models accounting for nonquantity and quality. Computers can be instructed to deal with intricate models accounting for non-linearities, heterogeneities, complex geometries, and erratic initial and boundary conditions. To link inputs and outputs of linear, time-invariant, and causal systems, only the unit impulse response (UIR) needs to be known. Thus recharge and discharge of water are linked by the instantaneous unit hydrograph (IUH), while the input and output of solutes are linked by the travel time density distribution (TTDD). Ideally, the IUH and TTDD should be derived from the equations describing the flow of the water and solutes, but in many cases one must be satisfied with fits of empirical equations to input/output data. Examples of both approaches are discussed, and a direct comparison of the responses to changes of water quantity and quality can be made if, for particular systems, both the IUH and the TTDD are known. The response to changes in quantity is, in many cases, found to be swifter than the response to changes in quality, even in the absence of adsorption, fixation, and decay of solutes. (See also W87-05100) (Author's abstract) abstract) W87-05101

CHANGE OF GROUNDWATER QUALITY IN THE YUN-LIN BASIN DUE TO OVER-PUMP-

ING, National Taiwan Univ., Taipei. Dept. of Agricultural Engineering.

Y. S. 18ao.
IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 33-43, 7 fig. 3 tab, 3 ref.

Descriptors: *Groundwater quality, *Yun-Lin Basin, *Pumping, *Groundwater management, Saline water intrusion, Groundwater depletion, Coastal aquifers, Hydraulic models, Finite element

Yun-Lin basin, with an area of 1075 sq km, has 6508 deep wells, and an exceptionally high well density of ore than 6/sq km. Over-pumping and

heavy dependence on groundwater have resulted in a progressive deterioration of groundwater quality. In this report, historical water quality data are analyzed to determine relationships between rate of pumping and changes in groundwater quality. Sea water intrusion in the coastal area as well as health hazards caused by deterioration of groundwater quality are also discussed. In a comparison study involving the finite element method, simulation suggested that decline in groundwater level may be overcome by modifying the location of pumping fields without significant reduction in the quantity abstracted. A further proposition is to remove all the ill-effects of over-pumping. In exploring this proposition, the present level to remove all the ill-effects of over-pumping. In exploring this proposition, the present hydraulic model has been expanded to incorporate chemical transport in providing a hydrodynamic perspective of Yun-Lin basin. A continuing collaboration between the geohydrology and medical discipline is still needed for greater understanding and remedies for health hazards caused by drinking contaminated groundwater. (See also W87-05100) (Lantz-PTT)

GROUNDWATER CHANGES IN THE URBAN AREA OF WROCLAW IN THE PERIOD 1874-

1974, Akademia Rolnicza, Wrocław (Poland). Inst. of Hydro- and Geotechnics. For primary bibliographic entry see Field 2F. W87-05105

EXPLOITING LAYERS OF FRESH WATER FLOATING ON SALT WATER BY DRILLING AND CIRCULAR WELLS: THEORETICAL DRAWDOWNS AND MAXIMUM FLOWS AVOIDING SALINIZATION; OPTIMAL DRILLING DEPTH (EXPLOITATION DES NAPPES D'EAU DOUCE FLOTTANT SUR DES NAPPES D'EAU DOUCE PLOTTANT SUR DES EAUX SALEES PAR FORAGES ET PUTTS CIR-CULAIRES: RABATTEMENTS THEORIQUES ET DEBITS MAXIMAUX A NE PAS DE-PASSER POUR EVITER LA SALINISATION; PROFONDEUR OPTIMALE A DONNER AUX

Dakar Univ. (Senegal). Lab. d'Hydraulique.

D. Gourieres.

IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 145-158, 6 fig. 1 tab, 1 ref.

Descriptors: *Drilling, *Water yield, *Saline-freshwater interfacers, *Saline water, *Salinization, *Groundwater management, Groundwater potential, Groundwater quality, Drawdown, Aquifers, Porous media, Pumping wells.

The pumping of water from a well sunk into a fresh water aquifer floating above salt water causes a rise of the fresh water/salt water interface beneath the well. Assuming the fresh water aquifer is replenished and the level of the interface does not reach the bottom of the well, the author establishes a semi-theoretical, semi-experimental formula for determining the water discharge as a function of the drawdown. The maximal drawdown and discharge avoiding salinization of the well are then derived from the previous relationship. The problem is solved for unconfined and confined, fresh water aquifers floating above salt water and contained in homogeneous and isotropic porous media. (See also W87-05100) (Author's abstract)

HEAT AND MASS TRANSPORT IN SATURAT-ED-UNSATURATED GROUNDWATER FLOW, Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Wasserbau und Wasserwirtschaft und Inst. fuer Wasserbau. For primary bibliographic entry see Field 2F. W87-05114

KALMAN FILTER IN GROUNDWATER BASIN SIMULATION - A SENSITIVITY STUDY WITH A SYNTHETIC EXAMPLE.

Watershed Protection—Group 4D

Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Wasserbau und Wasserwirtschaft und Inst. fuer Wasserbau. H. Sacher. IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 167-177, 8 fig, 9 ref.

Descriptors: *Groundwater basins, *Mathematical models, *Kalman filters, *Sensitivity analysis, *Simulation, *Model studies, Groundwater management, Groundwater quality, Mathematical analysis, Permeability coefficient, Hydraulic load.

Regional groundwater models have become an important tool for describing the results of human impact on groundwater basins. Unfortunately, there are a number of problems hampering the optimal use of these models when applied to practical problems. The sources of uncertainties may be summarized as follows: (1) simplifying assumptions in the mathematical formulation of the flow in account media (discrete in space and time). summarized as follows: (1) simplifying assumptions in the mathematical formulation of the flow in porous media (discrete in space and time); (2) estimation of model parameters for the spatially distributed hydraulic coefficients and storage coefficients; (3) estimation of the initial state, model inputs, and boundary conditions (system dynamics); and (4) uncertain measurements of head (system observation). To analyze the influence of these uncertainties in model boundary conditions, model inputs and measurements, the finite element method is used for the simulation of the groundwater flow and the Kalman filter for updating the simulated system state. A synthetic example has been chosen to investigate all terms of uncertainty in a completely controlled system. The interdependence between the filter estimates for the system state and the estimated covariance matrices of the uncertainty sources is shown by systematic, successive perturbation of each covariance matrix. (See also W87-05100) (Lantz-PTT)

PUMPING FROM MULTIPLE WELLS REDUCES WATER PRODUCTION REQUIRE-MENTS: RECOVERY OF MOTOR VEHICLE FUELS, LONG ISLAND, N.Y., New York State Dept. of Transportation, Hyde Park Paging 10 New York State Dept. of Transportation, Park. Region 10. For primary bibliographic entry see Field 5F. W87-05152

4C. Effects On Water Of Man's Non-Water Activities

ACID RAIN SPURS CLEAN-COAL RESEARCH, For primary bibliographic entry see Field 5B. W87-04371

SOIL AND GROUNDWATER SALINITY ALONG DRAINAGE DITCHES IN EASTERN NORTH DAKOTA, North Dakota State Univ., Fargo. Dept. of Soil

R. L. Skarie, J. L. Richardson, A. Maianu, and G.

R. Clambey.

Journal of Environmental Quality JEVQAA, Vol. 15, No. 4, p 334-340, October-December 1986. 4 fig. 5 tab, 18 ref. USDA Grant 83-CRSR-2-2307.

Descriptors: *Saline soils, *Soil salinity, *Ground-water pollution, *Path of pollutants, *Water pollu-tion sources, *Drainage ditches, *Red River Valley, *Salinity, North Dakota, Hydrology, Seep-age, Ponds, Recharge, Runoff, Productivity.

Excessive salinity has been estimated to affect nearly 250000 ha of land in the lacustrine plain of the Red River Valley of North Dakota. The probthe Red River Valley of North Dakota. The prob-lem is generally associated with high vater tables resulting from artesian pressures and poor drain-age. The most severely affected saline soils in the Red River Valley of North Dakota are normally observed in linear patterns along shallow roadside drainage ditches. Although the affected areas tend

to be small, taken as a group they represent a considerable loss of productivity. Research was conducted to study the relationship between soil salinity and groundwater hydrology adjacent to roadside drains. Data for groundwater depth, electrical conductivity, and chemistry indicated that significant seepage occurs from the ditches. During recharge periods, both depth and salinity of groundwater tended to increase with distance from the drain. Ratios of Ca(2+) to Mg(2+) tended to decrease over the same distance. Maximum salinity of the soil surface was observed where groundwater was of intermediate depth and salinity for a given site. Soils near the drain were most saline at the surface, whereas soils beyond the influence of the ditch exhibited increasing salinity with depth. Seepage rates calculated from soil and groundwater parameters did not correlate with observed values of soil salinity for a given site. The degree of salinization appears more closely related to the frequency that surface water ponds in the drain. Pond permanence was inferred by wetland classification of the drains according to the plant species present. (Alexander-PFT)

EFFECT OF DEFORESTATION AND SUBSIST-ENCE AGRICULTURE ON RUNOFF OF THE KAFUE RIVER HEADWATERS, ZAMBIA, National Council for Scientific Research, Lusaka (Zambia). Water Resources Research Unit. For primary bibliographic entry see Field 2E. W87-04564

UPLAND AFFORESTATION: INFLUENCES ON STREAM HYDROLOGY AND CHEMIS-

of Terrestrial Ecology, Bangor (Wales).

Bangor Research Station.

M. Hornung, and M. D. Newson.

Soil Use and Management, Vol. 2, No. 2, p 61-65, June 1986, 35 ref.

Descriptors: *Reforestation, *Stream hydrology, Stream chemistry, England, Hydrology, Sediment load, Water resources, Stream biota, Fisheries, Site preparation, Fertilization, Reviews.

The existing research on large-scale reforestation was reviewed and areas where scientific investigation was essential for sound decisions about land use and the management of both timber and water resources were highlighted. Afforestation in the British uplands could lead to changes in the hydrology, sediment load and chemistry of streams. These changes could affect water resource management costs, stream biots and the health of fisheries. Some of the changes could be related to specific phases of the forest management cycle, site preparation, fertilization and felling, for example. Other changes in water yield and chemistry seemed to have complex origins in forest-atmosphere and forest-soil interactions; these were more difficult to counteract. (Wood-PTT) W87-04574

ARE EUCALPYTS ECOLOGICALLY HARM-

FUL, D. Poore, C. Fries, G. de la Lama, W. de P. Lima, and C. Malvas. Unasylva, Vol. 38, No. 152, p 19-22, 1986.

Descriptors: *Eucalyptus, *Forestry, *Ecological effects, Nutrients, Catchment areas, Erosion, Planting management, Roots, Competing use, Erosion, Vegetation.

In an extract from a newly published UN Food and Agriculture Organization study, the ecological effects of eucalyptus trees are reviewed in terms of the economic and social consequences of their cultivation and use as a plantation species. There is inconclusive evidence that eucalypt plantations may decrease the water yield of catchments because the strong surface roots of some eucalypts compete vigorously with ground vegetation and neighboring crops where water is in short supply. Eucalypts are not good trees for erosion control under dry conditions because ground vegetation is suppressed by root competition. A natural eucalypt

forest appears to control leaching and runoff of nutrients as well as other natural forests. There is an accumulation and incorporation of organic matter where eucalyptus are planted in bare sites. Because of rapid growth, eucalyptus cropping on ahort rotation leads to rapid depletion of nutrient reserves. Ground vegetation is less affected by competition with eucalyptus in wet conditions than in dry, when it may be greatly reduced and leave the soil bare and prone to erosion. There is no universal answer to the question of planting eucalyptus and each case must be examined on its individual merits. (Michael-PTT) W87-04886

APPLIED CARRYING CAPACITY CONCEPT FOR INTEGRATING STORMWATER MAN-AGEMENT AND LAND USE PLANNING, A CASE STUDY: THE KUANTU PLAIN TAIPEI, TAIWAN,

National Chunghsing Univ., Taichung (Taiwan). Graduate Inst. of Urban Planning. For primary bibliographic entry see Field 4A. W87-0503

EFFECT OF ARIZONA'S 1980 GROUND WATER CODE ON THE PREVENTION OF GROUND WATER DEGRADATION FROM AG-GROUND WATER DESTRICTION FROM AG-RICULTURAL PRACTICES, Arizona State Dept. of Health Services, Phoenix. For primary bibliographic entry see Field 5G. W87-05084

DEGRADATION OF GROUNDWATER RE-SOURCES CAUSED BY INADVERTENT LAND MISUSE,

Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5C.
W87-05116

4D. Watershed Protection

CONCENTRATED FLOW EROSION ON CON-VENTIONAL AND CONSERVATION TILLED WATERSHEDS, Agricultural Research Service, Council Bluffs, IA. For primary bibliographic entry see Field 2J. W87-04923

RUNOFF AND EROSION AS AFFECTED BY CORN RESIDUE: PART I. TOTAL LOSSES,

Nebraska Univ.-Lincoln. J. E. Gilley, S. C. Finkner, R. G. Spomer, and L.

Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 157-160, January-February 1986. 3 fig, 1 tab, 18 ref.

Descriptors: *Runoff, *Erosion control, *Soil loss, *Rainfall simulators, *Sediments, Regression analysis, Iowa, Loess, Surface cover.

ysis, Iowa, Loess, Surface cover.

A thin surface seal with decreased infiltration capacity may develop near the soil surface as a result of raindrop impact. Residue cover reduces soil compaction caused by impacting raindrops thus helping to maintain a greater infiltration rate. Residue cover also protects a portion of the soil surface from raindrop impact, thus reducing soil detachment. A reduction in sediment transport capacity of flow could result from smaller runoff velocities caused by surface residue. Both of these factors may contribute to reduced sediment concentration. The effects of varying rates of corn residue on runoff and erosion from a loess soil in southwestern lowa were measured using a rainfall simulator. Consistent reductions in runoff, sediment concentration and soil loss resulted from increased residue application. Small amounts of surface cover produced substantial reductions in erosion. A regression equation relating surface cover to residue weight was obtained. Equations describing relative runoff, sediment concentration and soil loss as a function of surface cover were also developed using regression analysis. (See also W87-04927) (Alexander-PTT)

Field 4—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4D—Watershed Protection

RUNOFF AND EROSION AS AFFECTED BY CORN RESIDUE: PART II. RILL AND INTER-RILL COMPONENTS,

J. E. Gilley, S. C. Finkner, R. G. Spomer, and L. N. Mielke

Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 161-164, January-February 1986. 6 fig. 19 ref.

Descriptors: *Runoff, *Erosion control, *Rills, *Soil loss, *Rainfall simulators, *Sediments, Slope, Soil conservation, Erosion rates, Iowa.

Upland soil erosion is classified into rill and inter-rill components. Rill erosion consists of the remov-al of soil by concentrated flow in small, but well defined channels. The existence of rills indicates defined channels. The existence of rills indicates the potential for excessive erosion. Interrill erosion in contrast, takes place in the region of shallow overland flow occurring between rills. Raindrop impact is the primary soil detaching mechanism on interrill regions. Soil particles detached by raindrop impact may be transported from the impact area by shallow overland flow. Hydraulic and soil loss variables were measured under simulated rainfall conditions at selected downslope distances on mu condutions at selected downslope distances on plots with corn residue rates ranging from 0.00 to 6.73 t/ha. Application of corn residue produced substantial reductions in runoff rate, runoff veloci-ty, sediment concentration and soil loss rate along the entire slope lenath. On those plots subject to the entire slope length. On those plots subject to rilling, runoff rate, sediment concentration and soil loss rate usually increased with downslope dis-tance. Rill and interrill sediment concentration and soil loss rate were also measured at selected slope lengths. Interrill sediment concentration changed lengths. Interrill sediment concentration changed little with downslope distance while greater interrill soil loss rates were observed with increasing alope length. Rill sediment concentration and soil loss rate increased rapidly near the bottom of the plots. (See also W87-04926) (Alexander-PTT) W87-04927

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

FLOW-INJECTION DETERMINATION OF NI-TRATE IN NATURAL WATERS WITH COPPER- AND COPPERISED CADMIUM TUBES IN THE REACTION MANIFOLD

SYSTEM,
Pretoria Univ. (South Africa). Dept. of Chemi
J. F. van Staden, A. E. Joubert, and H. R. van

Vitet. Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 325, No. 2, p 150-152, September 1986. 2 fig, 1 tab, 9 ref.

Descriptors: *Automation, *Water analysis, *Spectral analysis, *Spectrophotometry, *Flow-injection spectrophotometry, *Nitrates, *Natural waters, *Reaction manifold system, Azo dyes, Sampling

An automated method is described for the determination of nitrate-N in surface, ground, and domestic water based on flow-injection spectrophotometry. Nitrate is reduced to nitrite with a copperated cadmium tube in the reaction manifold. Nitrite is diazotized with sulfanilimide and the product is constant with N. (I can be able to the product is a can be able to the product is a constant with N. (I can be able to the product is a can be able to the product is a constant with the product is a constant with the product is a can be able to coupled with N-(1-naphthyl)ethylenediammonium dichloride to form a highly colored azo dye, which is measured at 520 nanometer. A copper tube, incorporated into the reaction manifold before the copperized cadmium tube not only improves accuracy in the long run, but also extended the lifetime of the coperized cadmium tube. The sampling rate is 50 samples per hour. The method is suitable for the determination of nitrate-N with a coefficient of variation of better than 1.5%. (Author's

ANTIBIOTIC RESISTANCE AND TRANSFER-ABLE RESISTANCE IN ENTEROBACTERIA-CEAE IN MUNICIPAL WASTE WATERS,

Vyskumny Ustav Preventivneho Lekarstva, Bratis-

Hava (Czechoslovakia).

K. Kralikova, V. Kromery, and V. Kromery.

Recombinant DNA Technical Bulletin RDTBD5, Vol. 9, No. 2, p 59-64, June 1986. 6 tab, 28 ref.

Descriptors: *Resistant bacteria, *Pollutant identification, *Wastewater treatment, *Antibiotic resistance, *Municipal wastewater, *Enteric bacteria, *Biological wastewater treatment, Gentamycin, Carbenicillin, Ampicillin, R plasmids, Bacteria.

The incidence of antibiotic-resistance Enterobacteriaceae and incidence of strains with transferable resistance were studied in 647 isolates using antibiotic disks. High levels of gentamycin (GEN) resistance were found in 13.9% of isolates from wastewaters, which surpassed the level of resistance level in isolates from patients with urinary tract infections. The level of resistance to carbenicillin (CAR) also surpassed the levels of CAR resistance observed in patients: 81.9% of Escherichia coli and 91.0% of the Salmonellae from wastewaters were CAR resistant. The most frequent resistant determinant found in bacteria isolated for wastewaters was that to ampicillin (AMP) quent resistant determinant found in bacteria isolated for wastewaters was that to ampicillin (AMP) and CAR, although others were found. In 166 antibiotic-resistant E coli strains isolated from municipal wastewaters, 21 combination of resistance to 7 antibiotics tested could be demonstrated. Eighteen combinations of resistance were observed in 152 antibiotic-resistant Klebsiella/Enterobacter strains. Biological treatment of wastewaters stimulated a 3-5% decrease in the incidence of resistant E coli strains, but there was a marked increase in resistant Proteus species. Strains of bacteria from municipal wastewater carried R plasmids at relatively high frequency (3-57.7%). This transferable resistance appeared to be concentrated in strains of Klebsiella spp. (Rochester-PTT)

DEVICE FOR SAMPLING THE MUD-WATER INTERFACE IN EUTROPHIC LAKES AND BOGS FOR RESIDUE ANALYSIS,

Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences. For primary bibliographic entry see Field 7B. W87-04383

MONITORING OF ABIOTIC COMPART-MENTS FOR TRACE METALS: DIFFICUL-TIES, STRATEGIES AND USE OF SURVEYS, Nederlands Inst. voor Onderzoek der Zee, Texel. For primary bibliographic entry see Field 7B. W87-04384

SPECTRAL INTERFERENCES IN THE QUAN-TIFICATION OF ARSENIC IN WATER SAM-PLES BY INDUCTIVELY COUPLED PLASMA EMISSION SPECTROMETRY, Hydrological Research Inst., Pretoria (South

Alricaj.
E. Davies, and P. L. Kempster.
Spectrochimica Acta (B) SAASBH, Vol. 41, No. 11, p 1203-1209, November 1986.

Descriptors: *Spectral analysis, *Chemical analysis, *Pollutant identification, *Arsenic, *Spectroscopy, Water analysis, Laboratory equipment, Detection limits, Heavy metals.

Wavelength profiled obtained on an inductively coupled plasma (ICP) scanning monochromate were used for confirmation of arsenic in water samples following screening analysis on an ICP polychromator. Profile scans of four arsenic polychromator. Profile scans of four arsenic atomic lines were investigated for their usefulness for confirmation and quantification. Background structure was characterized, and detection limits and sensitivity were determined. Three arsenic lines were found to have adequate sensitivity and detection limits for establishment of compliance with the maximum permissible South African drinking water criterion for arsenic of 0.3 mg/l As. Background structure influenced the reliability of the detection limit Spectral interferences were inbackground substitute interferences were in-vestigated using single element standards. Signifi-cant interferences were found from aluminum, cad-mium, chromium, cobalt, and vanadium on one or

several of the arsenic emission lines tested. (Author's abstract) W87-04469

INFLUENCE OF MINERAL NUTRITION, OZONE AND ACID MIST ON THE MONOTERPENE PATTERN OF NEEDLES OF PICEA ABIES (L.) KARST (EINFLUSS VON MINERALSTOFFERNAEHRUNG, OZON UND SAUREM NEBEL AUF DAS MONOTERPENMUSTER DER NADELN VON PICEA ABIES

(C.) KARST), Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Botanik.

R. Schoenwitz, and L. Merk.
Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 258-261, September 1986. 1 fig, 1 tab, 9 ref.

Descriptors: *Water pollution effects, *Nutrients, *Air pollution, *Tissue analysis, *Acid rain, *Air pollution effects, *Spruce trees, *Ozone, *Fertiliza-tion, *Bioindicators, *Terpenes, *Acid fog, *Plant

This study seeks to provide evidence as to whether the monoterpenoids could serve as bioindicators of air pollution. The percentage contents of monoterpenes from plants exposed to different experimental conditions were separately analyzed according to needle age. Different terpene patterns exist (e.g. camphene, camphor, borneol) but may not relate to any of the experimental conditions. (Airone-PTT) PTT W87-04496

INVESTIGATIONS COMPARING THE INFLU-ENCE OF SPRUCE (PICEA ABIES (L.) KARST) AND BEECH (FAGUS SYLVATICA L.) ON THE QUALITY OF SEEPAGE WATER (VERGLEI-CHENDE UNTERSUCHUNGEN UEBER DEN EINFLUSS VON FICHTE (PICEA ABIES (L.) AUF DIE SICKERWASSERQUALITAET),
Munich Univ. (Germany, F.R.). Lehrstuhl fuer For primary bibliographic entry see Field 5B. W87-04510 Bodenkunde.

ORGANIC ACIDS IN SPRINGTIME WISCONSIN PRECIPITATION SAMPLES, Battelle Pacific Northwest Labs., Richland, WA. For primary bibliographic entry see Field 5B. W87-04514

FLUORIDE CYCLING IN NATURE THROUGH

PRECIPITATION,
Bhabha Atomic Research Centre, Bombay (India).
Air Monitoring Section.
For primary bibliographic entry see Field 5B.
W87-04515

DETERMINATION OF TRACE METALS IN RAIN WATER BY DIFFERENTIAL-PULSE STRIPPING VOLTAMMETRY, Antwerp Univ., Wilrijk (Belgium). Dept. of Chem-

istry. L. Vos, Z. Komy, G. Reggers, E. Roekens, and R.

Van Grieken.
Analytica Chimica Acta ACACAM, Vol. 184, p 271-280, June 30, 1986. 4 fig, 3 tab, 16 ref. Belgian Ministry of Science Contract 84-89/67, EEc Grant ENV-768-B/RS.

Descriptors: *Measuring instruments, *Pollutant identification, *Water pollution sources, *Voltametry, *Trace metals, *Rainfall, *Precipitation, *Acid rain, Metals, Heavy metals, Pollutants, Sample preparation, Detection limits, Optimization, Performance evaluation.

Differential-pulse stripping voltammetry was used to measure zinc, cadmium, lead and copper by anodic stripping and selenium (IV) by catholic stripping in rain water at pH 2; consequently, at pH 9.1, manganese was measured by anodic stripping on the same portion, and cobalt and nickel were measured in the adsorptive mode after formation of their dimethylglyoximates. The instrumen-

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Identification Of Pollutants-Group 5A

tal parameters were optimized, and the linear ranges, mutual interferences and detection limits were studied. Excellent accuracy was demonstrated; the standard deviation was around 15% at 2.5.0 microgram/L levels. The method was shown to be applicable for rain water. (Author's abstract)

ENZYME TEST FOR DETERMINING ISOMA-LATHION IMPURITIES IN WATER-DISPERS-IBLE POWDERS OF MALATHION,

Yugoslav Academy of Sciences and Arts, Zagreb. Inst. for Medical Research and Occupational Health.

E. Reiner, and Z. Radic Bulletin of the World Health Organization BWHOA6, Vol. 64, No. 3, p 397-401, 1986. 3 fig, 1 tab, 5 ref. WHO Project V2/181/169.

Descriptors: *Pollutant identification, *Water pollution sources, *Sample preparation, *Malathion, *Enzymes, *Insecticides, *Pesticides, *Pesticides, *Theilayer chromatography, Catalysts, Toxicity, Chromatography, Phytotoxicity, Poisons, Wastewater, Sludge, Spectral analysis, Defection limits.

An enzyme test for determining isomalathion impurities in water dispersible powders of malathion (WDP). In this test, the organophosphorus impurities in WDP malathion were extracted with methanol. The diluted extract was then incubated with acetylcholinesterase. After 10 minutes the substrate acetylthiocholine iodide was added, and the residual enzyme activity was measured spectrophotometrically. The degree of enzyme inhibition proved to be proportional to the concentration of organophosphorous impurities. The lower limit of detection of the test was 0.01% (w/w) isomalathion. For 18 samples of WDP malathion there was good correlation between the levels of isomalathion found using the enzyme test and those obtained by thin-layer chromatography. (David-PTT)

DETERMINATION OF ORGANIC AND INOR-GANIC ACID SPECIES IN THE ATMOSPHERE AND IN RAIN-WATER BY ION CHRO-

PHERE AND IN RAIN-WALER BY ION CHRU-MATORGRAPHY, Consiglio Nazionale delle Ricerche, Rome (Italy). Ist. Inquinamento Atmosferico. D. Brocco, and R. Tappa. Journal of Chromatography JOCRAM, Vol. 367, No. 1, p 240-246, September 26, 1986. 2 fig, 3 tab, 13 cef.

Descriptors: *Pollutant identification, *Sample preparation, *Water pollution sources, *Acid rain, *Organic acids, *Inorganic acids, *Rain, *Ion chromatography, *Rome, Cellulose triacetate filters, Alkaline filters, Acetic acid, Ion exclusion chromatography, Atmosphere,

chromatography, Atmosphere,.

An accurate and sensitive method for the simultaneous determination of volatile organic acids and gaseous inorganic species in the atmosphere and rain-water is presented. The experiments were performed 30 km east of Rome. The sampling assembly consisted of two filters set in a series. To separate particulate and gaseous phases, a cellulose triacetate membrane filter was used together with an alkaline filter. The precipitation sample were collected on a daily basis using a wet/dry collector which exposed separate containers during wet and dry periods. Whatman 41 cellulose filters were riused in aqueous 1 M potassium hydroxide solution and dried under vacuum over silica gel. Metricel filters were used to collect particulate matter. Particulate water-soluble chloride, nitrate, sulphate and hydronium were determined. The impregnated filters used for collection of gaseous compounds were extracted with 10 ml of deionized water. The filter extracts and precipitation samples were analyzed for organic acides and for Cl(-), NO2(-), NO3(-), and SO4(2-). Two procdures were applied on chromatography (IC) and ion exclusion chromatography (IC) and ion exclusion chromatography (IC) coupled with IC. The organic acids in the sample were identified and quantitated by comparision with standards. Upon collection, the pH of precipitation samples was determined. In the filter series, the first filter was used to collect

particulate matter, the second and third were impregnated filters. The first and third showed very low concentrations of particulate organ whereas the second filter absorbed almost whereas the second filter absorbed almost all of the organic acids. These results indicated that the acids and inorganic species in the atmosphere were trapped mostly on a single potassium hydroxide impregnated filter after 24 h of sampling. Acetic acid was the most abundant organic species, followed by formic acid. Rain samples analyzed indicated a temporal variability and were not representative of the average composition of the acidic component of precipitation. (Main-PTT) W87-64534

DETERMINATION OF NITRATE AND SUL-PHATE IN RAIN-WATER BY CAPILLARY ISOTACHOPHORESIS, Komenskeho Univ., Bratislava (Czechoslovakia). Inst. of Chemistry.

Chemistry. iansky, I. Zelensky, P. Havasi, and M.

D. Kaniansky, I. Zelensky, P. Havasi, and M. Cerovsky. Journal of Chromatography JOCRAM, Vol. 367, No. 1, p 274-279, September 26, 1986. 1 fig, 3 tab, 35 ref.

Descriptors: *Nitrates, *Sulphates, *Water analysis, *Acid rain, *Rain, *Capillary isotachophoresis, Performance evaluation, Comparison studies, Drinking water, Fatty acid ions, Regression equations, Detection limits.

A more suitable system than capillary isotachophoresis (ITP) for analysis of inorganic anions present in surface and drinking water was investigated, and the performance of ITP in comparision to the approved wet-chemistry procedures was assessed. The separation unit was assembled in a coupled column configuration. Nitrate and sulphate were present in rain-water in similar concentrations, generally within the range 1-10 ppm. Anions of fatty acids were the only constituents considered potential interferents in the ITP analysis. The composition of the leading electrolyte was such as to combine the complexation effects of Mg(2+) with the retardation of sulphate via the electrophoretic and relaxation effects of both counter ionic constituents. As the effective mobimaga.+) with the retardation of sulphate via the electrophoretic and relaxation effects of both counter ionic constituents. As the effective mobilities of the separands were high under these conditions, a mobile terminating anion (acetate) was employed. The results of the quantitative analyses were derived from the electronically measured residence times of the zones in the conductivity detector of the analytical column. Using the experimental conditions described quantitive analysis of samples containing nitrate and sulphate concentrations of 0.35 and 0.25 ppm, respectively, were conducted. Deviations found in the determination of nitrate by different methods were evaluated as statistically insignificant. The results of the determinations of sulphate obtained by the different methods deviated with a high statistical significance. The same conclusions were drawn from the comparison of ITP with a low statistical significance. (Main-PTT) W87-04535 W87-04535

EVALUATION OF THE SIGNIFICANCE OF METAL-BINDING PROTEINS IN THE GASTROPOD LITTORINA LITTOREA, Marine Biological Association of the United Kingdom, Plymouth (England). For primary bibliographic entry see Field 5C. W87-04538

DISTRIBUTION OF CD, PB AND CU BETWEEN THE DISSOLVED AND PARTICULATE PHASE IN THE EASTERN SCHELDT AND WESTERN SCHELDT ESTUARY, KENTORSCHELDT ESTUARY, Kernforschungszentrum Karlsruhe G.m.b.H. (Ger-many, F.R.). Inst. fuer Heisse Chemie. For primary bibliographic entry see Field 5B. W87-04566

NICKEL-63 IN COLUMBIA RIVER SEDI-MENTS BELOW THE HANFORD RESERVA-Oregon State Univ., Corvallis. School of OceanogFor primary bibliographic entry see Field 5B. W87-04577

PLUTONIUM AND AMERICIUM IN ARCTIC WATERS, THE NORTH SEA AND SCOTTISH AND IRISH COASTAL ZONES, Lund Univ. (Sweden). Dept. of Radiation Physics. For primary bibliographic entry see Field 5B.

MIGRATION OF REACTOR-PRODUCED TRITIUM IN LAKE HURON, Helath and Welfare Canada, Ottawa (Ontario). En-ivronmental Radiation Hazards Div. For primary bibliographic entry see Field 5B. W87-04579

UO2(2+)-HUMATE INTERACTIONS IN SOFT, ACID, HUMATE-RICH WATERS, Michigan State Univ., East Lansing. Dept. of Fish-eries and Wildlife. For primary bibliographic entry see Field 5B. W37-04580

TIME-DOMAIN REFLECTOMETRY METHOD FOR MEASURING SOIL WATER CONTENT

AND SALINITY,
Agricultural Research Service, Riverside, CA. Salinity Lab. For primary bibliographic entry see Field 2G. W87-04595

ANALYSIS FOR TRACE AMOUNTS OF GEOS-MIN IN WATER AND FISH, Agricultural Research Service, New Orleans, LA. Southern Regional Research Center. H. P. Dupuy, G. J. Flick, A. J. St. Angelo, and G. Journal of the American Oil Chemists' Society JIASDH, Vol. 63, No. 7, p 905-908, July 1986. 2 fig, 20 ref.

Descriptors: *Fate of pollutants, *Sample prepara-tion, *Pollutant identification, *Tissue analysis, *Geosmin, *Trace levels, *Water analysis, *Fish, New Techniques, Centrifugation, Capillary gas chromatography, Gas chromatography, Chroma-tography, Detection limits.

The problem of recovery of the odor-causing geomin, which has a very low organoleptic threshold level, from fish tissue or water is addressed. Trace amounts of geomin (trans-1,10-dimethyl-trans-9-decaloi) were concentrated from relatively large decaio) were concentrated from relatively large volumes of water by vegetable oil extraction. After stirring the two phases for 30 minutes, the dispersed oil was allowed to separate. The oily layer was removed and centrifuged to break the emulsion and separate the two layers. The direct gas chromatographic technique was used to resolve the geosmin from other volatile components on a capillary gas chromatographic column. Volatiles were separated from the oil by securing an aliquot of the oil layer, on volatile-free glass awool in the capillary gas chromatographic column. Volatiles were separated from the oil by securing an aliquot of the oil layer on volatile-free glass wool in the glass liner of the special gas chromatography inlet system. Geosmin was detected at part per billion level with this simple and rapid technique. A technique also was developed for detecting geosmin in fash tissue; it involves steaming the fish to break up the tissue, centrifuging the residual oil phase, and detecting geosmin by capillary gas chromatography. The geosmin remains in the residual oil. (Wood-PTI) W87-04602

HYDROLYTIC STABILITY OF CHEMICALS -HYDROLYTIC STABILITY OF CHEMICALS -A COMPARISON OF EPA AND OECD PROTO-COLS AND SUGGESTIONS FOR A COM-BINED UNIVERSAL METHOD, Shell Research Ltd., Sittingbourne (England). Sit-tingbourne Research Centre. B. T. Grayson. Pesticide Science PSSCBG, Vol. 17, No. 3, p 277-286, June 1986. 6 tab, 13 ref.

Descriptors: *Water analysis, *Analytical methods, *Hydrolysis, *Hazardous materials, *Risks, *Risk

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A-Identification Of Pollutants

assessment, Sampling, Sample preparation, Standards, Comparison studies.

The guidelines for determining rates of hydrolysis as a function of pH from both the EPA and OECD as a function of pH from both the EPA and OECD contain an introductory section defining the purpose of such determinations. Briefly, since water is ubiquitous in the environment, chemicals introduced into it may degrade by hydrolysis. Thus hydrolysis is one of the most common abiotic reactions determining the persistence of a chemical in the environment. It is important therefore to be able to quantify the rates of that hydrolysis under conditions similar to those found in the environment. Comparison of the most recent EPA and OECD guidelines shows that there are small but significant differences in the protocols recommended for determining the rates of hydrolysis of industrial chemicals for environmental hazard assessment. The detailed conditions given in these guidelines, such as purity and concentration of active lines, such as purity and concentration of active ingredient, co-solvent, pH, buffer type and concentration, temperature, sampling times, and methods of analysis, were examined in relation to their of analysis, were examined in relation to their effects on the accuracy of the measured rates of hydrolysis. It is suggested that the two protocols could be made more similar while still obtaining results that will be sufficiently accurate for estimations of abiotic environmental persistence. (Alexander-PTT) W87-04614

QUANITIATIVE STRUCTURE-ACTIVITY RE-LATIONSHIPS IN AQUATIC TOXICOLOGY, Utrecht Rijksuniversiteit (Netherlands). Dept. of Veterinary Pharmacology, Pharmacy and Toxicol-

ogy. For primary bibliographic entry see Field 5C. W87-04615

EVALUATION OF MODELS USED TO ASSESS THE FATE OF CHEMICALS IN AQUATIC SYSTEMS,

Shell Research Ltd., Sittingbourne (England). For primary bibliographic entry see Field 5B. W87-04616

APPLICATION OF REVERSE-PHASE H.P.L.C. FOR THE DETERMINATION OF PARTITION

COEFFICIENTS,
Shell Internationale Research Maatschappij N.V.,
The Hague (Netherlands).
C. V. Eadsforth.

C. V. Eddstorth.

Pesticide Science PSSCBG, Vol. 17, No. 3, p 311-325, June 1986. 8 fig, 5 tab, 39 ref.

Descriptors: *Partition coefficients, *Fate of pol-lutants, *Path of pollutants, *Solubility, *Chroma-tography, *Organic compounds, Prediction, Re-tention time, Automation, Sampling, Data proces-ing, Solutes, Spectral analysis, Solvents, Correla-

tion analysis.

The assessment of the potential environmental hazards of industrial chemicals requires information about three major ecotoxicological properties; irrespective of the use of the chemicals or the way in which they reach the environment: firstly, their acute toxicity to aquatic organisms; secondly, the rate at which they degrade in the natural environment; and thirdly (especially for those products which are shown or expected to degrade slowly) their tendency for bioaccumulation. Reverse-phase high performance liquid chromatography (h.p.l.c.), using a C18 analytical column, was applied to the determination of partition coefficients for a range of agrochemicals and industrial chemicals. Using a correlation plot of the logarithm of the capacity factor (k) with the logarithm of the n-octanol/water partition coefficient P sub ow, partition coefficients were predicted with a 95% tolerance interval of + or - log 0.80 of the literature 'shake flask' value for compounds of random structure over the log P sub ow range 0-6. Individual regression lines were fitted for compounds of comparable size and functional grouping, which reduced any bias and thereby enabled more accurate predictions to be made. The reverse-phase h.p.l.c. method has a number of advantages over the traditional 'shake-flask' method. Quantitative methods are not renumber of advantages over the traditional 'shake-sk' method. Quantitative methods are not re-

quired or do not have to be developed and only the determination of the retention time is necessary. Quick and precise determinations of retention times are facilitated by h.p.l.c. and further improvement can be obtained by automation of solvent mixing, solute injection and data processing. H.p.l.c. was used to generate partition coefficient data for highly hydrophobic materials and, because of its resolving power, data for mixtures and solvent fractions. Dual detection, using u.v. and r.i. in series, was necessary for some compounds, particularity. vent fractions. Dual detection, using u.v. and r.i. in series, was necessary for some compounds, particularly unknown mixtures and impure compounds. Calculations of log P sub ow based on the fragment-addition method using the structural data file, MACCS, was of considerable value in confirming experimentally derived values. In certain cases, calculated log P sub ow values were considered more trustworthy than experimental values. (Alexeder PUTS)

FIELD TESTING OF A LARGE VOLUME LIQUID-LIQUID EXTRACTION DEVICE FOR HALOGENATED ORGANICS IN NATURAL

National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div B. G. Oliver, and K. D. Nicol.

International Journal of Environmental Analytical Chemistry IJEAA9, Vol. 25, No. 4, p 275-285, 1986. 1 fig, 5 tab, 12 ref.

Descriptors: *Measuring instruments, *Water analysis, *Sample preparation, *Extraction, *Trace levels, *Organic compounds, *Halogenated compounds, Field tests, Performance evaluation, Recovery, Detection li

In most environmental research, there is a need to measure the concentration of organic chemicals in measure the concentration of organic chemicals in the water phase. For wastewater samples, simple liquid-liquid extraction procedures on sample volumes of 4 L or less are usually adequate to provide sufficient analytical sensitivity. When wastewater discharges have been diluted and chemicals are lost from the water phase by volatilization and/or association with suspended sediments or biota, the concentrations in the aqueous phase are usually very low. The testing of a large volume (200 litre) liquid-liquid extractor for trace organics in the laboratory and in the field is described. The recovery efficiency of the device, as measured by laboratory spiking experiments and field spiking of five surrogate chemicals, was reasonably consistent and in the 40-70% range. Concentration and cleanup procedures for the extract are described in detail. The device reduces the detection limits of the organic chemicals by one or two orders of magnitude over those achieved with conventional small volume (1-10L) samples. (Alexander-PTT) the water phase. For wastewater samples, simple liquid-liquid extraction procedures on sample vol-

SIMPLE DEVICE FOR ISOLATION OF OR-GANIC COMPOUNDS FROM WATER, Gdansk Technical Univ. (Poland). Inst. of Inorgan-ic Chemistry and Technology.

M. Biziuk, and J. Namiesnik.
International Journal of Environmental Analytical
Chemistry IJEAA9, Vol. 26, No. 3/4, p 193-207,
1986. 9 fig, 3 tab, 29 ref. Polish academy of Sciences Grant MR. I-15.

Descriptors: *Measuring instruments, *Water anal-ysis, *Organic compounds, *Organochlorine com-pounds, *Sample preparation, Performance evalua-tion, Isolation, Temperature, Oxidation, Coulometry, Chloride

One of the basic analytical techniques used in the area of analysis of organic pollutants of various types of water (surface water, tap water, industrial effluents, etc.) is gas chromostores to the property of the property types of water (surface water, tap water, industrial effluents, etc.) is gas chromatography. The type of matrix represented by water causes limitations in maximum sample volume which can be directly introduced into a GC column. Usually, in the case of direct aqueous injection (DAI) this sample volume is on the order of several microliter(uL) whereas in particular cases the injected aqueous sample does not exceed 400 uL. A simple device for isolation of organic compounds from aqueous samples was designed and its operating parameters

tested during both periodic and continuous operation using isolation of organochlorine compounds as an example. A stream of an aqueous sample is pumped at elevated temperature by a piston pump to an unit for expansion of the liquid phase surface, where the liquid is sprayed on the walls of the unit and flows down freely. Organochlorine compounds passing to the gaseous phase are purged with a stream of purified air, oxidized and the chlorides formed are determined coulometrically. The designed device, due to its simplicity, can be built and employed in each averagely equipped laboratory. (Author's abstract)

LONG-CHAIN ALKYLBENZENES: THEIR AN-ALYTICAL CHEMISTRY, ENVIRONMENTAL OCCURRENCE AND FATE, chusetts Univ. at Boston. Environmental Sci-

For primary bibliographic entry see Field 5B. W87-04622

LINEAR ALKYLBENZENE SULFONATES (LAS) IN SEWAGE SLUDGES, SOILS AND SEDIMENTS: ANALYTICAL DETERMINATION AND ENVIRONMENTAL SAFETY CON-

SIDERATIONS,
Procter and Gamble European Technical Center,
Brussels (Belgium).
H. De Henau, E. Mathijs, and W. D. Hopping.
International Journal of Environmental Analytical
Chemistry UEAA9, Vol. 26, No. 3/4, p 279-293,
1986 1.58; 9 245, 427 e47. 1986. 3 fig, 9 tab, 32 ref.

Descriptors: *Alkylbenzene sulfonates, *Anionic surfactants, *Detergents, *Fate of Pollutants, *Suludge, *Sediments, *Pollutant identification, *Chromatography, *Waste disposal, *Land disposal, Wastewater treatment, Transport, Prediction, Risks, Benthos.

Linear Alkylbenzenesulphonates (LAS), a major anionic surfactant used in laundry products, can be measured specifically in the environment by instru-mental analysis. In addition to a desulfonation-gas chromatography approach, a method based on high performance liquid chromatography was de-veloped. The main features of the methods are outlined, and LAS concentrations measured in sewage sludge, sediments and sludge amended soils are reported. Knowledge of usage volumes, sewage treatment practices and environmental transport and transformation mechanisms has been transport and transformation mechanisms has been used to predict concentrations of LAS. These calculated concentrations were found to agree well with those actually measured in the environment. Both measured and calculated ambient concentrations of LAS are below those which could produce potentially adverse effects in representative surface water, benthic and terrestrial organisms. (Author's abstract)
W87-04623

TOTAL PHOSPHORUS ANALYSIS OF WASTEWATER SAMPLES USING THE STAN-NOUS CHLORIDE REDUCTION PROCE-DURE.

South Australia Engineering and Water Supply Dept., Salisbury. State Water Labs. B. C. Nicholson. International Journal of Environmental Analytical Chemistry IJEAA9, Vol. 23, No. 4, p 305-319, 1986. 7 fig, 1 tab, 12 ref.

Descriptors: *Wastewater analysis, *Phosphorus, *Sample preparation, *Fate of pollutants, *Colorimetry, Detection limits, Salinity, Absorbance, Spectral analysis.

Phosphorus reaches natural waters from many sources. A major source is sewage and sewage effluents where the input from phosphates incorporated in synthetic detergents is considerable. As phosphorus is an essential nutrient in the eutrophication process, accurate methods of analysis are important in water pollution studies. The stannous chloride reduction procedure for the colorimetric determination of total phosphorus in wastewater samples using potassium persulphate digestion was

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Identification Of Pollutants—Group 5A

evaluated. Samples with salinities as low as 50 mg/l gave phosphorus levels approximately 10% lower than the true levels when absorbance readings were taken after the recommended time interval of were taken after the recommended time interval of to minutes. With increasing salinity, the error increased to approximately 20%. This error can be overcome by the addition of sodium chloride to both standards and samples to achieve salinity levels of 2,000 mg/l or greater, and making absorbance measurements after allowing at least 2 but not more than 3 minutes for color development. (Alexander, PIT)

KINETIC-FLUORIMETRIC DETERMINATION OF SELENIUM IN THE ENVIRONMENT WITH USE OF METHYLENE BLUE, Palma de Mallorca Univ. (Spain). Dept. of Analyt-ical Chemistry.

Palma de Mallorca Univ. (Spain). Dept. of Analytical Chemistry.

F. Grases, G. Genestar, and R. Forteza.
International Journal of Environmental Analytical
Chemistry IJEAA9, Vol. 23, No. 4, p 321-329,
1986. 2 fig, 3 tab, 11 ref.

Descriptors: *Selenium, *Kinetics, *Spectrofluori-metry, *Trace levels, *Sample preparation, *Pol-lutant identification, Detection limits, Bases, Sul-fides, Water analysis, Heavy metals, Spectral anal-

No method for the kinetic determination of selenium based on the appearance of fluorescence is to be found in the literature. A kinetic-fluorimetric method for determination of traces of selenium (0.01-0.4 ppm) is described. It is based on the fact that the reducing power of alkali sulfides can be considerably enhanced by the addition of elemental selenium. The experimental variables and interferences were studied. The selenium quantities are estimated in diverse environmental samples. (Alexander-PTT) ander-PTT) W87-04631

ANALYSIS OF POLYCYCLIC AROMATIC HY-DROCARBONS IN SEDIMENTS, SEWAGE SLUDGES AND COMPOSTS FROM MUNICI-PAL REPUSE BY HPLC, Tuebingen Univ. (Germany, F.R.). Inst. fuer Or-ganische Chemie.

ganische Chemie.

H. Hagenmaier, H. Kaut, and P. Krauss.
International Journal of Environmental Analytical
Chemistry IJEAA9, Vol. 23, No. 4, p 331-345,
1986. 10 fig. 2 tab, 17 ref.

Descriptors: "Polycyclic aromatic hydrocarbons, "Sediments, "Compost, "Sludge, "Municipal wastes, "HPLC, "Chromatography, "Pollutant identification, "Fate of pollutants, Extraction, Wastewater, Substrates, Organic compounds, Aromatic compounds, Hydrocarbons.

The extraction of 6 selected PAHs, Fluoranthene, Benzo(b)fluoranthene, Benzo(a)pyrene, Benzo(gh)perylene and Indeno(1,2,3-cd)perylene was improved by hot soxhlet extraction with hexane/acetone. Overall concentrations for sediments (Neckar) lie between 4.6 and 21.8 mg/kg (mean value 8.6 mg/kg). The corresponding values for the other substrates are waste water 129-2504 (791) ng/kg; sewage sludge 2.2-20.4 (9.7) mg/kg; municipal refuse 0.06-187 (6.9) mg/kg and waste compost 107-173.4 (14.7) mg/kg. It can therefore be concluded, that in all sinks of PAHs (sediments, sewage sludge and municipal refuse) the content is roughly the same. The PAH pattern of sediments and sewage sludges is very constant for different sampling sites. In contrast organic municipal waste shows marked pattern variations. For waste water treatment plants a positive correlation between daily water input and PAH content could be shown. PAH pattern comparison shows decreasing inhomogeneity from municipal refuse over sewage sludge to river sediments. (Author's abstract) The extraction of 6 selected PAHs, Fluoranther

DETERMINATION OF ULTRA TRACE AMOUNTS OF COBALT IN FISH BY GRAPH-ITE FURNACE ZEEMAN EFFECT ATOMIC ABSORPTION SPECTROMETRY

Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.
J. W. McMahon. A. F. Danker.

tario), Chalk River Nuclear Labs.
J. W. McMahon, A. E. Docherty, J. M. A. Judd, and S. R. Gentner.
International Journal of Environmental Analytical Chemistry IJEAA9, Vol. 24, No. 4, p 297-303, 1986. 2 fig, 2 tab, 8 ref.

Descriptors: *Tissues analysis, *Path of pollutants, *Trace levels, *Cobalt, *Spectrometry, *Sample preparation, Heavy metals, Fish, Chelation, Extraction, Spectral analysis.

traction, Spectral analysis.

Trace amounts of cobalt are essential to the metabolism of both terrestrial and aquatic biota. However, the study of cobalt uptake by biota, particularly in freshwater ecosystems, has been limited mainly because the sensitivity of instrumentation for analysis of cobalt has been inadequate to measure low concentrations. A method is described for determining stable cobalt concentrations in fish flesh and bone using polarized Zeeman effect graphite furnace atomic absorption spectrometry (ZAAS). Cobalt analysis on freshwater fish flesh samples (10 g dry weight) required predigestion and wetashing at 70-80 C. Cobalt is chelated with memority may prolidine dithiocarbamate (APDC) extracted with methyl isobutyl ketone (MIBK) and analyzed by ZAAS. The mean cobalt content calculated from the standard additions method using three replicate fish flesh samples was 4.23 + or -1.0 microgram Co/Kg (dry weight). Analyses were also carried out on flesh and bone samples from similar sized fish, of the same species, taken from three area lakes. (Alexander-PTT)

QUANTITATIVE DETERMINATION OF TRACE CONCENTRATION OF ORGANICS IN WATER BY SOLVENT EXTRACTION AND FUSED SILICA CAPILLARY GAS CHROMA-TOGRAPHY: ALIPHATIC AND POLYNU-CLEAR HYDROCARBONS, National Centre for Scientific Research, Havanna

L. G. Bravo, and L. Rejthar. International Journal of Environmental Analytical Chemistry IJEAA9, Vol. 24, No. 4, p 305-318, 1986. 4 fig. 5 tab, 9 ref.

Descriptors: *Trace levels, *Water analysis, *Sample preparation, *Chromatograpy, *Organic compounds, *Extraction, *Hydrocarbons, Detection limits, Recovery, Aromatic compounds, Con-

The contribution of the PAHs to drinking water is small compared to other sources and generally aquatic PAHs represent a minor source of PAHs in the human environment but it is not possible to minimize their importance. Solvent extraction procedures with six different solvents on aqueous model systems of aliphatic (C12-C22) and polynuclear aromatic hydrocarbons (PAHs: naphthalene, cacenaphthene, fluorene, phenanthrene, anthracene, fluoranthene and pyrene) were studied for analysis in the trace concentration range (20-50 ng/ml) by fused silica capillary gas chromatography. Recovery efficiencies, reproducibilities and detection limits for each analyte and procedure are reported. The effect of the PAHs on the extracting rate of the aliphatic hydrocarbons at the trace concentration range is discussed. (Alexander-PTT)

HANDLING OF ENVIRONMENTAL AND BIO-LOGICAL SAMPLES VIA PRE-COLUMN TECHNOLOGIES, Vrije Univ., Amsterdam (Netherlands). Dept. of Analytical Chemistry. For primary bibliographic entry see Field 7B. W87-04635

SOLID-PHASE EXTRACTION AND CAPIL-LARY GAS CHROMATOGRAPHIC DETERMI-NATION OF TRIAZINE HERBICIDES IN WATER,
Florida Univ., Gainesville. Pesticide Research

Lab. P. C. Bardalaye, and W. B. Wheeler.

International Journal of Environmental Analytical Chemistry IJEAA9, Vol. 25, No. 1-3, p 105-113, 1986. 3 fig, 1 tab, 15 ref.

Descriptors: *Extraction, *Chromatography, *Sample preparation, *Triazines, *Herbicides, *Water analysis, Trace levels, Sampling, Sorption, Detection limits, Descrption.

Pollution of groundwater, streams and wells by synthetic organic chemicals has been recognized as an important environmental problem within the last few years. It is increasingly apparent that water is being contaminated by various waste disposal activities. A facile and efficient method is described for the determination of trace quantities of triazine herbicides, terbutryn, prometryn and ametryn in water. The procedure involved preconcentration of water samples by sorption on chromatographic grade silica gel particles with chemically modified surface, being covalently bonded with a monofunctional CSH17 group. This was followed by solvent desorption with 2-propasol. The determinative step was achieved by capillary gas chromatography on Supelcowas-10 fused silica column using a nitrogen-phosphorus detector. The limit of detection was 0.1 microgram(ug) - 10ug/L. (Alexander-PTT) nder-PTT)

MULTICOLUMN ION CHROMATOGRAPHIC DETERMINATION OF NITRATE AND SUL-FATE IN WATERS CONTAINING HUMIC SUBSTANCES, Lund Univ. (Sweden). Dept. of Analytical Chem-

E. Hoffmann, G. Marko-Varga, I. Csiky, and J. A. Jonsoon. International Journal of Environmental Analytical Chemistry IJEAA9, Vol. 25, No. 1-3, p 161-171, 1986. 5 fig, 1 tab, 16 ref.

Descriptors: *Chromatography, *Nitrates, *Sulfates, *Decomposing organic matter, *Water analysis, *Natural waters, Humic acids, Ion exchange, Anions, Detection limits, Trace levels.

The analysis of nitrate and sulfate in natural waters is of great biological and environmental signifi-cance. A large variety of traditional techniques has been used for their determination. All these techbeen used for their determination. At these techniques are influenced by the presence of humic substances in the samples and there is a continuous need for selective methods. A three-column ion chromatographic system for the removal of humic substances from natural waters, and subsequent online concentration and determination of nitrate and subsequent online concentration and determination of nitrate and subsequent online concentration and determination of nitrate and concentrations. nne concentration and determination of intrate and sulfate using non-suppressed ion chromatography is presented. Humic substances are removed using disposable adsorption columns packed with chemi-cally bonded amine silica material. The sample is directly transferred to an ion exchange column where the anions are concentrated ca. 10 times. After reversing the flow, the ions are transferred to a third column where they are separated and quantified. The detection limit is less than 1 mg/L of nitrate or sulfate in water containing 45 mg/L of humic acid. (Alexander-PTT) W87-04637

USE OF SERUM ANTIBODY AS A MEANS TO DETERMINE INFECTIONS FROM EXPOSURE TO WASTEWATERS AND REFUSE, Cincinnati Univ., OH. Dept. of Environmental

C. S. Clark, and C. C. Linnemann.

CRC Critical Reviews in Environmental Control CCECAU, Vol. 16, No. 4, p 305-326, 1986. 1 fig, 12 tab, 55 ref. USPHS ES 00159.

Descriptors: "Bioassay, "Water pollution effects, "Population exposure, "Serum antibodies, "Infection, "Refuse, "Wastewater treatment, "Reviews, Diseases, Pathology, Sludge, Pathogemic viruses, Viruses, Bacteria, Parasites, Fungi, Algae.

Serum antibody levels have been used to document prior infection with pathogenic viruses and bacte-ria and, to a lesser extent, with certain parasites and fungi. This review is organized by pathogen type: viruses, bacteria, parasites, fungi, and algae

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

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and by wastewater and wastewater sludge and refuse operations including: wastewater collection and treatment, land application of wastewater sludge and effluent, and reuse collection and disposal. In general, the studies done on the use of seram antibody as a means to determine the risk of infections from exposure to wastewater and wastewater sludge in the past 10 years, have shown the risk to be minimal. There was evidence in four of the five wastewater worker studies reviewed, that exposure to wastewater/sludge carried with it a slight risk of viral infection. Most bacteria were not a problem. The sercepidemiologic approach to risk of infection in individuals exposed to wastewater provided a convenient method for studying a variety of diseases, some of the problems associated with this method were also discussed. (Wood-PTT)

CHEMICAL AND MICROPHYSICAL STUDIES OF NONPRECIPITATING SUMMER CLOUD IN ONTARIO, CANADA,

Atmospheric Environme (Ontario).

Por primary bibliographic entry see Field 5B. W87-04677

ANALYSIS OF REMOTE MEASUREMENTS OF TROPOSPHERIC CABBON MONOXIDE CONCENTRATIONS MADE DURING THE 1979 SUMMER MONSOON EXPERIMENT (MONEX).

Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences. For primary bibliographic entry see Field 2B. W87-0463

GAS FILTER RADIOMETER FOR CARBON MONOXIDE MEASUREMENTS DURING THE 1979 SUMMER MONSOON EXPERIMENT

National Aeronautics and Space Administration, Hampton, VA. Langley Research Center. H. G. Reichle, H. A. Wallio, J. C. Casas, and E. P.

Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 9, p 9841-9848, August 20, 1986. 10 fig. 3 tab, 9 ref. NASA Cooperative agreement NCC1-34.

Descriptors: "Measuring instruments, "Calibra-tions, "Radiometers, "Monsoons, "MONEX, "Carbon monoxide, "Radiometry," Remote sen-ing, Numerical simulation, Simulation, Gas chro-matography, Error analysis, Performance evalua-

A nadir-viewing gas filter radiometer operates in the 4.67 micron region of the fundamental band of carbon monoxide. The angular field of view is 4.33 degrees, yielding an instantaneous filed of view of 0.9 km at the surface from an aircraft altitude of 12 km. The instrument is similar in principle to the selective chopper radiometer that was used to measure atmospheric temperature from the Nimbus 4 satellite and to the gas filter radiometer which was used to measure carbon monoxide from an aircraft. The implementation of the technique is different from that used in those instruments in that the instrument signal balance between the gas and vacuum legs is maintained electronically by a continuous automatic gain control circuit. The instrumental and data reduction techniques used in obtaining remote measurements of carbon monoxide during the 1979 Summer Monsoon Experiment are described. The form of the signal function (the variation of signal with altitude) and the impact of variations in the vertical distribution of carbon monoxide are discussed. Estimates of the experimental accuracy are made both by the assessment of error sources through the use of numerical simulations and by comparison with concurrent measurements made by means of gas chromatography. It is found that the radiometric measurements tend to be about 9% lower than the direct measurements and to have a precision of about 8%. (Author's abstract)

CONDITIONS FOR MINIMUM ADSORPTION OF ZINC ON CONTAINER SURFACES, Al-Najah Univ., Nablus (Israel). R. Salim, and H. S. Hilal. Journal of Environmental Science and Health (A) JESEDU, Vol. 21, No. 7, p 681-690, October 1986.

Descriptors: *Sample preparation, *Sampling storage, *Sampling, *Zinc, *Adsorption, *Containers, *Chemical solutions, *Chemical storage, Storage, Ions, Ion concentration, Hydrogen ion concentration, Container types, Container ahapes, Metal ions, Metals.

Adsorption of zinc on container surfaces and various factors affecting the amount of this adsorption were investigated. These include the pH, the conwere investigated. These include the pH, the con-centration of zinc ions in solution, treatment of the surface, the type of container, the shape of the container, pre-saturation of the container surface with metal ions, and the presence of foreign ions in solution. The best conditions for storing zinc solu-tions have been concluded. Zinc solutions are best acidified and stored in polythene containers or, when it is necessary to avoid acidification, in steel containers. (Author's abstract)

DETERMINATION OF FLUORENE IN FISH,

DETERMINATION OF FLUORENE IN FISH, SEDIMENT, AND PLANTS, Columbia National Fisheries Research Lab., MO. J. A. Lebo, and L. M. Smith. Journal-Association of Official Analytical Chemists Journal JANCA2, Vol. 69, No. 6, p 944-951, November-December 1986. 3 fig. 5 tab, 26 ref.

Descriptors: *Pollutant indentification, *Sample preparation, *Chromatography, *Fluorene, *Chemical analysis, *Fish, *Sediments, *Plants, *Tissue analysis, Gels, Activated carbon, Adsorbents, Liquid chromatography, Ultraviolet detection, Fluorescence detection, Detection limits,

Methods and their applications are described for the determination of fluorene in fish, sediment, and plants. Sample extracts are enriched by using two or more of the following: gel permeation, silica gel potassium silicate, sulfuric acid-impregnated silica gel, and activated carbon. Efficiency was imgel, and activated carbon. Efficiency was improved by applying the adsorbents in combination or as tandem enrichment modules. Analysis by liquid chromatography (LC) with ultraviolet or fluorescence detection (LC/UV or LC/F) yielded limits of detection of 30, 3, and 30 ng/g and average recoveries of 80, 81, and 74% for fish, sediment, and plants respectively. (Author's abstract) stract)

SURROGATE-ASSISTED DETERMINATION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN FISH BY ELECTRON CAPTURE CAPILLARY GAS CHROMATOGRAPHY, Food and Drug Administration, Contaminants Chemistry Div. R. A. Ni

R. A. Niemann.

Journal-Association of Official Analytical Chemists Journal JANCA2, Vol. 69, No. 6, p 976-980, November-December 1986. 2 fig, 5 tab, 8 ref.

Descriptors: *Pollutant identification, *Tissue analysis, *Sample preparation, *Chemical analysis, *Fish, *Electron capture capillary gas chromatography, *Chromatography, Liquid chromatography, Dioxin, Quantitative analysis, Toxins, Hazardous materials, Bioaccumulation.

Surrogate spiking the sample with 1000 parts per trillion (ppt) 1,3,7,8-tetrachlorodibenzo-p-dioxin (1378-TCDD) has doubled analytical throughput in determining toxic 2378-TCDD (analyte) at the low part-per-trillion level in fish, using multicolumn high resolution liquid chromatographic cleanup before quantitation by capillary gas chromatography with electron capture detection. The 1378- and 2378-TCDD were recovered equally and were well separated by the capillary column so that the earlier-cluting surrogate did not interfere with the quantitation of levels of analyte

many-fold lower. Matrix interference contributed < 1% bias in surrogate quantitation. Using surrogate recovery to correct for analyte losses during analysis, accuracy averaged (n = 7) 105% in determining 18 or 45 ppt 2378-TCDD added to fish without detectable bioincurred analyte. Analysis of selected fish with bioincurred 2378-TCDD gave results comparable to earlier work where recovery selected itsin with bioincurred 2378-TCDD gave results comparable to earlier work where recovery correction required a second analysis of sample fortified with analyte. With surrogate fortification, repeatability of determination (n = 3 or 4) im-proved markedly to < 5% relative standard devi-ation at 37-46 ppt. (Author's abstract) W87-04691

SIMULTANEOUS GAS CHROMATOGRAPHIC DETERMINATION OF DIBUTYLTIN AND TRIBUTYLTIN COMPOUNDS IN BIOLOGICAL AND SEDIMENT SAMPLES, Shiga Prefectural Inst. of Public Health and Environmental Science, Otsu (Japan).

T. Tsuda, H. Nakanishi, T. Morita, and J.

1. 1800a, ri. ruaansan, Takebayashi ation of Official Analytical Chemists Journal JANCA2, Vol. 69, No. 6, p 981-984, November-December 1986. 2 fig. 3 tab, 12 ref.

Descriptors: *Pollutant identification, *Sample preparation, *Dibutyltin compounds, *Tributyltin compounds, *Gas chromatography, *Chromatography, *Gas chromatography, *Sidological samples, *Sediment analysis, Chemical reactions, Electron capture gas chromatography, Column chromatography, Detection lieute.

A method is described for the simultaneous deter-mination of nanogram amounts of dibutyltin and tributyltin compounds in biological and sediment tributyltin compounds in biological and sediment samples. These compounds are converted to the corresponding chlorides with HCl, extracted with ethyl acetate-hexane (3 + 2) for biological samples and with hexane for sediment samples, and hydrogenated with sodium borohydride. The corresponding hydrides, Bu2SnH2 and Bu3SnH, are detected by electron-capture gas chromatography after cleanup by silica gel column chromatography. Detection limits are 1.0-2.0 and 0.5-1.0 ag/g, respectively, for biological and sediment samples. (Author's abstract)

ON-LINE TRACE ENRICHMENT FOR DETER-MINATION OF ALDICARB SPECIES IN WATER, USING LIQUID CHROMATOGRA-PHY WITH POST-COLUMN DERIVATIZA-

National Hydrology Research Inst., Calgary (Al-

D. Ciaput.

Journal-Association of Official Analytical Chemists Journal JANCA2, Vol. 69, No. 6, p 985-989, November-December 1986. 5 fig, 4 tab, 9 ref.

Descriptors: *Pollutant identification, *Aldicarb, *Pesticides, *Liquid chromatography, *Chromatography, *Groundwater, Aldicarb sulfoxide, Aldicarb sulfox, Hydrolysis, Chemical reactions, Fluorescence, Detection limits, Toxicity.

Aldicarb, one of the most acutely toxic registered pesticides, has been reported in groundwater in areas characterized by coarse, sandy, acidic soils with shallow water table conditions and cool temperatures. To determine amounts of aldicarb and its oxidation products accurately at a sub-microgram/liter level, a liquid chromatography method was developed that takes advantage of the selective of a prescenting decreasing and the was developed that takes advantage of the selectivity of a post-column derivatization system and the increased sensitivity associated with an on-line trace enrichment procedure. Sensitivity is increased by loading a 10 mL volume of groundwater on a concentrator column installed in the loop position of a 6-port injection valve. Switching valves allows the concentrated material to be backfushed onto the analytical column by a methanol-water gradient mobile phase. Separation is followed by post-column hydrolysis to yield methylamine, and formation of a fluorophore with ophthalaldehyde and 2-mercapto-ethanol prior to fluorescence detection. The process requires virtually no sample cleanup and provides good preci-

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sion on recoveries from different matrixes. Minimum detection limit, defined as 5 times baseline noise, is less than 70 ng/L for aldicarb, aldicarb sulfoxide, and aldicarb sulfone. (Wood-PTT) W87-04693

MEASURING DRY DEPOSITION: A RE-AS-SESSMENT OF THE STATE OF THE ART, National Oceanic and Atmospheric Administra-tion, Oak Ridge, TN. Air Resources Atmospheric Turbulence and Diffusion Lab. B. B. Hicks

Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 75-90, September 1986. 4 fig, 37 ref.

Descriptors: *Pollutant identification, *Water analysis, *Water pollution sources, *Acid rain, *Air pollution, *Dry deposition, *Atmospheric physics, Reviews, Mathematical models, Monitoring, Tech-

The aura of uncertainty associated with the wide range of atmosphere/surface exchange processes collectively known as 'dry deposition' continues to be aggravated by an inability to make direct measurements except in very limited circumstances. The exchange process known as dry deposition encompasses the dynamic exchange of trace gases and aerosol particles, and the gravitational settling of large particles. Except for particles large enough that their sedimentation velocity exceeds turbulent velocities, the rate of deposition is mostly determined by surface properties, such as roughness, stickiness, and wetness, and by atmospheric stability. Thus, it is difficult to interpret results obtained using collection devices having surfaces different from those of nature. Other methods for measuring dry deposition exist, mostly micromedifferent from those of nature. Other methods for measuring dry deposition exist, mostly micrometerorological, but these are sufficiently complicated that routine application as in a monitoring network is not yet feasible. For some chemical species and in some locations, inferential methods offer considerable promise. These methods measure atchemical species, and derive relevant deposition velocities (V sub d) on a site-specific, speciedependent, and time-evolving basis. The dry deposition rates of interest are then evaluated as the product V sub d x C. A major goal of current research programs is to provide the knowledge necessary to evaluate V sub d. Experimental methods are reviewed, and potential sources of error are examined, for both the research methods and the 'concentration monitoring' methodologies pres-'concentration monitoring' methodologies preently being advocated for use in numerical models as well as for routine monitoring. (Alexander-PTT) W87-04699

ATMOSPHERIC MEASUREMENTS OF NI-TROGEN DIOXIDE WITH A SENSITIVE LU-MINOL INSTRUMENT, Unisearch Associates, Inc., Concord (Ontario). For primary bibliographic entry see Field 7B. W87-04701

CHEMICAL COMPOSITION OF PRECIPITA-CHEMICAL COMPOSITION OF PRECIPITA-TION AT LONG ISLAND, NY, Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment. Y. N. Lee, J. Shen, and P. J. Klotz. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 143-152, September 1986. 3 fig. 1 tab, 21 ref. DOE Contract DE-ACO2-76CHOOO16.

Descriptors: *Pollutant identification, *Acid rain, *Precipitation, *Snow, *Water pollution sources, *Chemical analysis, Seasonal variation, Diurnal variation, Nitrates Ions, Rainfall, Long Island, New York, Brookhaven National Lab.

In recent years much attention has been focused on the 'acid rain' phenomenon because the acidic pre-cipitation is believed to be responsible for adverse environmental effects such as modification of lake ecology and damage to forests. In order to gain a better understanding of the processes that play major roles in acid production as well as of wet deposition with respect to species and concentra-tions, chemical composition of precipitation has to be characterized. Chemical analyses were per-

formed on 387 sequential precipitation samples, both rain and snow, collected at Brookhaven National Laboratory, Long Island, New York, on 96 different days during the period from October 1983 to June 1985. The collection time for each individual sample was typically 30 min. The chemical species determined and the volume-weighted average and maximum concentrations (in natentheses) ual sample was typically 30 mm. The chemical species determined and the volume-weighted average and maximum concentrations (in parentheses) in units of micromolar were: H202:7(120), H2CO:6(60), H(+):51(500), NO3(-):30(350), SO4(2-):25(270), NH4(+):18(250), Ca(2+):3(48), NA(+):32(400), and Cl(-):37(380). A strong seasonal dependence was observed for H2O2 concentration, the maximum concentration in summer (120 micromolar) being 6 times greater than in winter. In addition, H2O2 concentration also exhibited a strong diurnal variation, with a maximum peaking in the afternoon and a minimum after midnight. These observations suggest that the production of H2O2 may be governed by photochemical activity. Nitrate concentration also displayed a strong diurnal variation, having a maximum around noon, but did not show a seasonal dependence. Relationships between various species and their possible sources are briefly discussed. (Alexander-PTT)

COMPARISON OF SUMMER AND WINTER MEASUREMENTS OF ATMOSPHERIC NITROGEN AND SULPHUR COMPOUNDS, ric Environ

K. G. Anlauf, J. W. Bottenheim, K. A. Brice, and H. A. Wiebe.

Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 153-160, September 1986. 3 fig, 9 ref.

Descriptors: *Comparison studies, *Pollutant identification, *Acid rain, *Precipitation, *Water pollution sources, *Seasonal variation, Sulfur emissions, Air pollution, Ontario.

Past studies have shown that annual mean sulfate rast source move about the same as ni-trate in precipitation in eastern North America. However, on a seasonal basis, more recent studies have shown large variations in their relative connave snown large variations in their relative contributions to precipitation acidity. The relative contributions of these species to the acidity in precipitation are controlled by the ambient gasphase and aerosol chemical make-up. Even though photochemical reactions are thought to be the driving force behind the formation of these atmosdriving force behind the formation of these atmospheric acidic compounds, it is not expected that atmospheric chemical reactivity is negligible in winter. Rather, there may be a shift in the relative contribution of N and S species to atmospheric acidity. Summer and winter concentrations of acidic atmospheric species and their precursors were measured in central Ontario. Large seasonal differences in concentrations were observed for some species. The concentrations of primary emission species, SO2 and NOx, were much larger in some species. The concentrations of primary emission species, SO2 and NOx, were much larger in winter, whereas O3 and aerosol SO4(2-) were much reduced. HNO3, PAN and aerosol NO3(-) showed little seasonal change; PAN represented about 30% of the total oxidized nitrate. During pollution episodes and in summer, the molar ratio of nitrate (aerosol NO3(-) plus HNO3) to aerosol SO4(2-) was about 0.1 to 0.2; however, during winter, this molar ratio was about 1 to 2. (Alexander, PTT) W87-04706

EDDY CORRELATION MEASUREMENTS OF DRY DEPOSITION FLUXES USING A TUNA-BLE DIODE LASER ABSORPTION SPEC-TROMETER GAS MONITOR,

TROMETER GAS MONITOR,
Ontario Hydro Research Lab., Toronto.
G. C. Edwards, and G. L. Ogram.
Water, Air and Soil Pollution WAPLAC, Vol. 30,
No. 1/2, p 187-194, September 1986. 1 tab, 21 ref.
Canadian Electrical Association Contract 187 G

Descriptors: *Measuring instruments, *Dry deposi-tion, *Eddies, *Acid rain, *Spectrometers, *Spec-tral analysis, Field tests, Air pollution, Perform-ance evaluation, Rural areas, Deposition velocity, Deposition, Snow, Emissions.

Over the past 2 yr an instrument package based on a tunable diode laser absorption spectrometer (TDLAS) and a comprehensive micrometeorologi-Over the past 2 yr an instrument package based on a tunable diode laser absorption spectrometer (TDLAS) and a comprehensive micrometeorological instrument package has been developed for making dry deposition flux measurements using eddy correlation techniques. The physical processes that control dry deposition are investigated and dry deposition for various chemical species, surface types and meteorological conditions is quantified. An important objective of the first phase of the research was to develop the potential of the TDLAS to make fast response, high sensitivity infield measurements of trace gas concentrations. Preliminary results from the field testing and evaluation of the instrument package at a rural location are presented. Low deposition velocities were measured for NO2 and SO2 to snow. (Alexander-PITT) PTT) W87-04710

MEASUREMENT OF DRY DEPOSITION TO VEGETATIVE SURFACES, General Motors Research Labs., Warren, MI.

Valer, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 205-210, September 1986. 4 tab, 7 ref.

Descriptors: *Pollutant identification, *Acid rain, *Dry deposition, *Vegetation, *Path of pollutants, *Canopy, Oak trees, Pine trees, Forests, Scavenging, Leaves, Deposition velocity, Deposition.

During two successive summers, dry deposition was measured to forests: a hardwood canopy in 1983 and a pine canopy in 1984. In both studies air concentrations and dry deposition were measured at both the perimeter and interior locations of the canopy. Dry deposition was measured by washing the deposited material from the leaves. The results of the two studies are compared. In both canopies, ambient particle and gas concentrations on the interior were decreased relative to perimeter coninterior were decreased relative to perimeter con-centrations due to dry deposition scavenging by the canopy. Deposition of all species was higher to perimeter leaves than to interior leaves, due both to the lower concentrations and the lower wind speeds in the sheltered interior. The deposition velocities measured to the pine needles were simi-lar to the values measured to the oak leaves. (Alex-

MODELING OF THROUGHFALL CHEMISTRY AND INDIRECT MEASUREMENT OF DRY DEPOSITION, Oklahoma State Univ., Stillwater. School of

Chemical Engineering.

For primary bibliographic entry see Field 5B.

W87-04713

COMPOSITION OF PRECIPITATION AT SNO-QUALMIE PASS AND STEVENS PASS IN THE CENTRAL CASCADES OF WASHINGTON STATE. Central Washington Univ., Ellensburg. Dept. of

Chemistry. L. C. Duncan, E. B. Welch, and W. Ausserer. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 217-229, September 1986. 4 tab, 23 ref.

Descriptors: *Pollutant identification, *Water analysis, *Path of pollutants, *Water pollution sources, *Precipitation, *Acid rain, Elevation, Urban areas, Cascade mountains, Puget basin, Washington State, Washout, Regional analysis.

Bulk precipitation samples were collected weekly during the winters of 1984 and 1985 at two high elevation sites in the Washington Cascades. The Puget basin, west and upwind of the Cascade sites, includes an urban industrialized region with a variety of area and point sources of acidic oxides. The precipitation was found to be low in contaminant content with SO4(2) and NO3(5) concentrations as low or lower than those reported for remote pristine stations in the US or elsewhere. It is suggested that the reduced contaminant levels result from an interplay of the meteorological and washout factors unique to the region. (Author's abstract) W87-04714

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A—Identification Of Pollutants

PRECIPITATION CHEMISTRY MEASURE-PRECIPITATION CHEMISTRY MEASURE-MENT IN ALBERTA, Alberta Environmental Centre, Vegreville. H. L. Bertram, N. C. Das, and Y. K. Lau. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 231-237, September 1986. 3 fig, 2 tab, 7

Descriptors: "Pollutant identification, "Water analysis, "Precipitation, "Water pollution sources, "Alberta, "Acid rain, Acidity, Weather data collections, Seasonal variation, Temporal variation, Ions, Deposition, Acidity.

The Alberta and Federal Governments undertook the monitoring of precipitation in Alberta in the year 1977-78. From 1978 to 1984, the CANSAP (Canadian Network for Sampling Precipitation) network consisted of five monitoring sites and the Alberta Environment network consisted of six monitoring sites. The 1980 to 1984 data from the Alberta Environment network are examined. For the spatial distribution of pH CANSAP data were included. Samples were collected with Sangamo samplers and analyzed for the major ions, pH and acidity. The data were tabulated and analyzed for spatial distribution, seasonal variation, temporal trends, ionic character and wet sulfate deposition. The major ionic species in Alberta precipitation trems, tonic character and wer sunae reposition. The major ionic species in Alberta precipitation are Ca(2+), SO4(2-), NH4(+) and NO3(-). The spatial distribution shows a slight decrease in pH from southern Alberta (pH 6.0) to northern Alberta to (pH 5.4). The seasonal variation shows higher hydrogen ion content in the summer months (pH 5.4 in summer and pH 5.8 in winter). Temporal 5.4 in summer and pri 5.6 in winter). Temporal trends are not apparent over the five year period investigated. The five year average wet sulfate deposition rate in Alberta is 9.1 kg/ha/yr. (Alexander-PTT) W87-04715

RAINFALL ACIDITY IN NORTHERN BRIT-AIN - EXPLORING THE DATA, Institute of Terrestrial Ecology, Edinburgh (Scot-

J. N. Cape, and D. Fowler. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 239-244, September 1986. 6 fig, 8 ref.

Descriptors: *Acid rain, *Water pollution sources, *Pollutant identification, *Water analysis, *Precipitation, *Rainfall, Acidity, Scotland, Weather

There are many different ways of collecting precipitation to measure its acidity; collectors may be continuously-open (bulk) or wet-only, and may be sampled by event, daily, weekly or monthly. Even with identical collectors, the sampling period necessarily affects the distribution of measured pH and may also affect the precipitation-weighted average. Daily rainfall pH measurements from a site in south Scotland were found to have a bimodal distribution. Similarly, monthly data from a network of bulk rain collectors in northern Britain gave bimodal distributions. Sites with an annual average pH of 4.7 had occasional monthly pH values of pH 4 or less. The annual average pH was a poor indicator of the frequency of such acidic periods, and may not be a good indicator of potential effects. Data from a daily and monthly collector at the same site are compared and the discreptor at the same site are compared and the discrepto the theory of the compared and the discrepancies discussed. Daily pH measurements gave significantly greater acidities than monthly pH measurements, but these differences were small for months with rain-weighted pH < 5. (Alexander-PTT) PTT) W87-04716

SNOW CHEMISTRY IN THE FLIN FLON SNOW CHEMISTRY IN THE FLIN F AREA OF MANITOBA, 1981-1984, Manitoba Dept. of Environmental Manager Winnipeg. For primary bibliographic entry see Field 5B. W87-04718

NEW DATA FROM PEAT BOGS MAY GIVE A HISTORICAL PERSPECTIVE ON ACID DEPOrgh Univ., PA. Graduate School of Public

For primary bibliographic entry see Field 2J. W87-04732

DUAL-GAMMA ATTENTUATION FOR THE DETERMINATION OF POROUS MEDIUM SATURATION WITH RESPECT TO THREE

FILUIDS,
Princeton Univ., NJ. Water Resources Program.
L. A. Ferrand, P. C. D. Milly, and G. F. Pinder.
Water Resources Research WRERAQ, Vol. 22,
No. 12, p 1657-1663, November 1986. 3 fig. 3 tab,
38 ref. NSF Grant ECE-8501649, DOE Grant DE-

Descriptors: *Measuring instruments, *Path of pol-lutants, *Analytical methods, *Soil water, *Gamma radiation, *Groundwater pollution, Den-sity, Water, Soil chemistry, Trichloroethylene, Sand, Isotope studies, Saturation, Calibrations, Po-rosity, Transport.

A dual-gamma ray attenuation technique may be applied to the laboratory determination of the degree of saturation with respect to three immiscible fluids in a porous medium that has a bulk density independent of time. A proposed calibration technique uses samples of the medium containing only two of the fluids at one time and does not require spatial uniformity of porosity or of fluid contents within the sample. Given gamma attenu-ation data, the system parameters so obtained allow calculation of fluid contents in three-fluid aulow calculation of fluid contents in three-fluid samples. An experimental application of the technique in which the relative saturations of water, trichloroethylene, and air in a sand were measured demonstrates the potential for use in laboratory studies relevant to the transport of separate phase organic contaminants in groundwater. (Author's abstract) W87-04755

MICROSCOPIC EXAMINATION OF ACTIVAT-ED SLUDGE AND CONTROL OF AERATION

Salina Area Vocational-Technical School, KS.
For primary bibliographic entry see Field 5D.
W87-04806

ACCURATE BOD DETERMINATIONS, For primary bibliographic entry see Field 5D. W87-04808

CONCEPTUAL DESIGN FOR A GROUND-WATER QUALITY MONITORING STRATEGY, Iowa Univ., Iowa City. For primary bibliographic entry see Field 7A. W87-04817

PLANT VIRUSES IN RIVERS AND LAKES, Biologische Bundesanstalt fuer Land-Forstwirtschaft, Brunswick (Germany, F.R.). Inst. fuer Viruskrankheiten der Pflanzen. R. Koenig. Advances in Virus Research AUREA8, Vol. 31, p 321-333, 1986, 65 ref.

Descriptors: *Viruses, *Pollutant identification, *Vectors, *Plant viruses, *Rivers, *Lakes, Sewage, Decomposition, Reproduction, Hosts, Water sam-

seeds. So the consistency of the viruses from water samples, viruses identified so far (elongated, isometric), state of occurrence of plant viruses in waters, origin of plant viruses in environmental waters (release from undisturbed roots and decaying plant material, sewage), and uptake of viruses through roots and seeds are reviewed. Plant viruses obviously occur in large concentrations in rivers and lakes because they can be detected consistently even in small water samples of only a few 100 ml. Due to the selectivity of the test plants and the mechanism on which the detection of the viruses is based, ie, mechanical transmissibility, probably only a small percentage of the viruses actually present in a water sample will be detected. Most of the viruses identified so far belong to

groups of viruses that share a number of properties: lack of an aerial vector, reproduction in high concentrations in infected plants, abundant release from infected roots, stability, which permits them to infect plants via the roots without the aid of a vector, wide host range, and ability to spread readily to neighboring plants. Activities of man, such as irrigation with liquid manure, consumption of raw fruit and vegetables, and disposal of agricultural and horticultural products on dumps add to virus distribution mechanisms. (Rochester-PTT) W87-04821

GAS CHROMATOGRAPHY DETECTORS BASED ON CHEMILUMINESCENCE, Sievers Research, Inc., Boulder, CO. For primary bibliographic entry see Field 7B. W87-04831

PREDICTING AQUEOUS ALUMINIUM CON-CENTRATIONS IN NATURAL WATERS, Maine Univ. at Orono. Dept. of Botany and Plant Pathology. C. C. Cronan, W. J. Walker, and P. R. Bloom. Nature NATUAS, Vol. 324, No. 6093, p 140-143, November 13, 1986. 2 fig. 2 tab, 22 ref. Electric Power Research Inst contract RP 2365.

Descriptors: *Mathematical models, *Natural waters, *Water analysis, *Path of pollutants, *Aluminum trihydroxide, *Model studies, *Aluminum, *Toxicity, *Hydrogen ion concentration, *Acid rain, Humic acids, Adsorption, Soil water, Soil contamination, Soil chemistry, Solubility, Decomposing organic matter, Equilibrium, Acid soils.

A two-component equilibrium model is presented to account for the spatial and temporal variability in aqueous aluminum chemistry observed in natural waters draining different inorganic and organic environments. The model involves a solid phase humic adsorbent and a aluminum trihydroxide mineral phase. Inputs for the model are solution pH, copper-extractable organic aluminum and the titratable carboxyl content of soil humus. Results suggest that waters undersaturated in aqueous aluminum may actually be in equilibrium with a solid suggest that waters undersaturated in aqueous alu-minum may actually be in equilibrium with a solid phase humic adsorbent. This model may be suitable for application to studies of aluminum transport associated with acid deposition. (Michael-PTT) W87-04834

DIFFERENTIAL PULSE POLAROGRAPHIC DETERMINATION OF THIOL FLOTATION COLLECTORS AND SULPHIDE IN WATERS, Helsinki Univ. of Technology, Espoo (Finland). Dept. of Chemistry.
J. Leppinen, and S. Vahtila.
Talanta TLNTA2, Vol. 33, No. 10, p 795-799, October 1986. 9 fig, 2 tab, 20 ref.

Descriptors: *Pollutant identification *Measuring instruments, *Analytical methods, *Water analysis, *Polarographic analysis, *Thiol collectors, *Sulfides, *Flotation, Ethyl xanthate, Diethyl dithiophosphate, Diphenyl dithiophosphate.

pnospnate, Diphenyl dithiophosphate.

Thiol collectors and sulfide can be simultaneously determined by differential pulse polarography. Polarographic measurements were made with a PAR 174 A Polarographic Analyzer and a PAR 303 A static mercury drop electrode stand. Ethyl xanthate, diethyl dithiophosphate and diphenyl dithiophosphate were determined in concentrations from 10 micromolar to 2 millimolar and sulfide from 1 micromolar to 0.5 millimolar. Although this method is rapid and reliable, the exact behavior of thiol collectors must be known since the pattern of current peaks changes as the concentration increases. Slight problems arise in the simultaneous determination of sulfide and diphenyl dithiophosphate because there is only a small difference in the peak potentials of these two components. Results for determination of ethyl xanthate by ultraviolet spectrophotometry and by differential pulse polarography are also compared. (Michael-PTT)

DETERMINATION OF ORGANIC FORMS OF MERCURY AND ARSENIC IN WATER AND

Identification Of Pollutants-Group 5A

ATMOSPHERIC SAMPLES BY GAS CHROMA-TOGRAPHY-ATOMIC ABSORPTION, Toronto Univ. (Ontario). Inst. for Environmental Studies.

For primary bibliographic entry see Field 7B. W87-04838

THRESHOLDS IN EUTROPHICATION OF NATURAL WATERS,
Tsukuba Univ. (Japan). Inst. of Biological Sci-

ences. H. Seki.

Environmental Monitoring and Assessment EMASDH, Vol. 7, No. 1, p 39-46, July 1986. 5 fig,

Descriptors: *Water pollution effects, *Pollutant identification, *Population density, *Eutrophication, *Bacterioplankton, Organic carbon, Indicators, Organic matter, Seasonal variation.

An appropriate combination of bacteriological tests such as direct microscope counting of bacterioplankton may be useful in monitoring eutrophication. Water samples were collected from different trophic type waters. Direct microscopic counting with a phase contrast microscope was used to estimate bacterioplankton population density. The mesotrophic Shin-ike Pond was selected as a research site to analyze changes in pollution of bacterioplankton as a function of the concentration of dissolved organic matter. A short term experiment in the Saanich Inlet showed that solar energy reduction only retarded the responses of microorganisms to changes in the amount of organic matter in the dysphotic watermass but did not affect the general mesotrophic characteristic. Bacterioplankton in the natural and experimental environments could maintain different theoretical population densities, both of which would remain within the normal range for the mesotrophic environment. The annual fluctuation of bacterioplankton relative to dissolved organic matter in the surface water of different water types were compared. The bacterial abundance in surface water of Tokyo Bay fluctuated within mesotrophic ranges and was on the side of oligotrophy during winter and eutrophy during summer. A certain bacterial abundance from different types of waters sorted into the same common range can be separated into different characteristic groups when the abundance is correlated with dissolved organic carbon in the environment. (Michael-PTT) ate combination of bacteriological

WET DEPOSITION OF POLYCYCLIC AROMATIC HYDROCARBONS IN THE NETHER-

MATIC HYDROCARBONS IN THE NETHER-LANDS, Rijksinstitut voor de Volksgezondheid en Milieu-hygiene, Bilthoven (Netherlands). Lab. for Ecolo-gy, Water and Drinking Water. For primary bibliographic entry see Field 5B. W87-04880

INDUSTRIAL ANALYZER BY A POTENTIO-METRIC METHOD FOR TOTAL ORGANIC CARBON IN WATER, Compagnie Generale des Eaux, Paris (France). For primary bibliographic entry see Field 7B.

CHARACTERIZATION OF MAJOR AND MINOR ORGANIC POLLUTANTS IN WASTEWATERS FROM COAL GASIFICATION

PROCESSES,
Georgia Inst. of Tech., Atlanta. Dept. of Environmental Engineering.
M. F. Giabbai, W. H. Cross, E. S. K. Chian, and F.

M. P. Chalous, vi. 1. Color B. Dewalle.
International Journal of Environmental Analytical International JUEAA9, Vol. 20, No. 2, p 113-129, 1985. 6 fig, 1 tab, 18 ref.

Descriptors: "Water analysis, "Water pollution sources, "Pollutant identification, "Organic compounds, "Organic wastes, "Coal gasification, "Wastewater composition, "Wastewater analysis, "Gas chromatography, "Biological wastewater treatment, Solvents, Phenols, Cresols, Pyridines,

Anilines, Quinolines, Polycyclic aromatic hydro-carbons, Dibenzofuran, Aldehydes, Polarographic analysis, Pilot plants, Monitoring.

analysis, Pilot plants, Monitoring.

A program to characterize specific organic constituents of coal gasification wastewater was conducted to investigate the feasibility of anaerobic biological treatment of wastewater from a coal gasification pilot plant. Solvent extraction in acid and base conditions followed by glass capillary gas chromatography combined with several detectors were used to investigate major and minor extractable organic constituents. Direct aqueous injection on a polar glass capillary column was used for the major nonsolvent extractable organic constituents amenable to gas chromatography. The identity of 28 organic compounds was confirmed by comparison with pure standards. Phenol and three cresol isomers were identified as major wastewater constituents. Several substituted phenols, pyridines, adilenzofuran and aldehydes were either confirmed or tentatively identified as minor constituents. Although the organics identified did not account for the total organic content, which implies the presence of still unidentified highly polar compounds, the information was used to establish a data base for monitoring gasification wastewater biological treatment operations. Process monitoring data indicated that several organics were only partially removed by biological treatment. (Author's abstract)

W87-04883

POLYCYCLIC AROMATIC HYDROCARBONS IN SURFACE SEDIMENTS FROM THE ELIZABETH RIVER SUBESTUARY, William and Mary Coll., Gloucester Point, VA. Inst. of Marine Science.
R. H. Bieri, C. Hein, R. J. Huggett, P. Shou, and H. Slone.

H. Sione. International Journal of Environmental Analytical Chemistry IJEAA9, Vol. 26, No. 2, p 97-113, 1986. 4 fig, 3 tab, 34 ref. EPA Grant R-806012.

Descriptors: *Pollutant identification, *Path of pollutants, *Polycyclic aromatic hydrocarbons, *Sediments, *Elizabeth River, Coal, Wood preservatives, Chemical wastes, Chemical spills, Advection, Dispersion, Diffusion.

tion, Dispersion, Diffusion.

The concentration and nature of mainly aromatic and polar organic compounds in 28 surface sediment samples from the Elizabeth River were evaluated using a simple and relaible methodology that can be applied in a quasi routine manner. Analysis revealed that unsubsituted polynuclear aromatic hydrocarbons (PAH) were the major components of these sediments, thus indicating an origin from high temperature processes. The conspicuous absence of cyclopenta(c,d) pyrene in these samples is characteristic of an origin from coal. Concentrations of PAH were highest in the Southern Branch where the sum of 14 generally abundant pyrogenic PAH in one sample was 170 parts per million and could be traced to two massive spills of wood preservatives. This maximum concentration decreased exponentially toward the mouth of the river with a correlation coefficient of minus 0.92. A diffusion-advection model can be used to describe the dispersion of the spillled material, but quantitative understanding of the various factors will require more research of the physical details. (Author's abstract)

HEAVY METALS DISTRIBUTION IN THE MOUTH OF THE BESOS AND LLOBREGAT RIVERS (DISTRIBUCION DE METALES PE-SADOS EN LAS DESEMBOCADURAS DE LOS

RIOS BESOS Y LLOBREGAT (MEDITER-RANEO OCCIDENTAL)), Instituto de Investigaciones Pesqueras de Barcelo-na (Spain).

For primary bibliographic entry see Field 5B. W87-04914

DIATOM-INFERRED PH CALIBRATION OF LAKES NEAR WAWA, ONTARIO, Trent Univ., Peterborough (Ontario). Environ-

ental Centre. S. S. Dixit. Canadian Journal of Botany CJBOAW, Vol. 64, No. 1, p 1129-1133, June 1986. 4 fig, 4 tab, 29 ref.

Descriptors: *Limnology, *Acid rain, *Indicator organisms, *Hydrogen ion concentration, *Diatoms, *Lakes, Calibrations, Acidity, Canada, Statistical analysis, Multivariate analysis, Lake sediments, Acidic water.

ments, Acidic water.

The increase in the acidity of precipitation in a large area of southeastern Canada and eastern United States has threatened a large number of poorly buffered lakes. The lakes located near Nawa have also been affected. The paleolimnological approach has often been used in many lake regions to document the extent of recent lake acidification. Diatoms are commonly used in these studies. The most important aspect in this technique is to establish a quantitative relationship between the present lake-water pH and the subfossil diatoms deposited in the most recent sediments, or multiple regression analysis. In this study an attempt has been made to evaluate the significance of various diatom-inferred pH techniques with particular reference to their utility in pH reconstruction of lakes located near Wawa, Ontario. Surface-sediment diatoms of 28 lakes (pH 4.0-8.13) located northeast of Lake Superior were identified and enumerated. Lake water pH estimates were made enumerated. Lake water pH estimates were made using multiple regression analysis of selected diatom taxa and Hustedt's pH indicator groups, as well as by index alpha and index B. Multiple regression, using the abundance of pH indicator assemblages, appears to be the most suitable method for the studied lake region. (Author's abstract) stract) W87-04938

NATURAL AND ANTHROPOGENIC CAUSES OF LAKE ACIDIFICATION IN NOVA SCOTIA, Minnesota Univ., Minneapolis. Dept. of Ecology and Behavioral Biology. For primary bibliographic entry see Field 5B. W87-04985

REPRODUCTIVE FAILURE IN COMMON SEALS FEEDING ON FISH FROM POLLUTED COASTAL WATERS, Rijksinstitut voor Natuurbeheer, Texel (Netherlands). Dept. of Estuarine Ecology. For primary bibliographic entry see Field 5C. W87-04986

RAPID AND SIMPLE METHOD FOR THE DE-TECTION AND ENUMERATION OF ESCHER-ICHIA COLI IN CLEANSED SHELLFISH, Refild COLI IN CLEANSED SHELLE ISIN, Area Public Health Lab. Exeter (England). T. J. Humphrey, and A. H. L. Gawler. The Journal of Hygiene JOHYAY, Vol. 97, No. 2, p 273-280, October 1986. 1 fig. 2 tab, 30 ref.

Descriptors: *Testing procedures, *Sample preparation, *Analytical methods, *Pollutant identification, *Escherichia coli, *Sellfish, *Multiple-tube technique, Public health, Oysters, Mussels, Cultures, Incubation, Pollutants, Bacteria, Indole decessions, Cultures, Incubation, Pollutants, Bacteria, Indole decessions of the Pollutants o

A multiple-tube technique based on peptone water incubated at 44 C for 24 h followed by detection of indole was found to be sensitive and specific for the detection of Escherichia coli in oysters and mussels. The method has the advantage of providing rapid results and is both less expensive and less time-consuming than other MPN techniques. (Au-

PERSONAL EXPOSURES, INDOOR AND OUTDOOR AIR CONCENTRATIONS, AND EXHALED BREATH CONCENTRATIONS OF SELECTED VOLATILE ORGANIC COMPOUNDS MEASURED FOR 600 RESIDENTS OF NEW JERSEY, NORTH DAKOTA, NORTH CAROLI-NA AND CALIFORNIA, Harvard Univ., Cambridge, MA. Energy and En-vironmental Policy Center.

Field 5-WATER QUALITY MANAGEMENT AND PROTECTION

Group 5A-Identification Of Pollutants

For primary bibliographic entry see Field 5B. W87-05033

CONDUCTIVITY-TEMPERATURE STAND-ARDIZATION AND DISSOLVED SOLIDS ES-TIMATION IN A MEROMICTIC SALINE

LAKE, British Columbia Univ., Vancouver. Westwater

British Columbia Univ., Vallocated Research Centre.
K. J. Hall, and T. G. Northcote.
Canadian Journal of Fisheries and Aquatic Sciences CJFSDX, Vol. 43, No. 12, p 2450-2454, December 1986. 4 fig. 2 tab, 11 ref.

Descriptors: *Water analysis, *Dissolved solids, *Meromictic lakes, *Saline lakes, *Seasonal variation, *Conductivity, *Temperature, Chemical analysis, Lakes, Salinity, Mahoney Lake, Ions, Stratifi-

Any study in a lake to examine vertical, seasonal, and yearly changes in dissolved ions by conductivity measurements requires that a temperature adjustment be made. Studies on seasonal changes in micro-stratification in meromictic Mahoney Lake required investigation of appropriate temperature conductivity (T-C) adjustments and conductivity dissolved solids relationships. In situ conductivity measurements were adjusted to 25 C using a series of T-C relationships determined in the laboratory for Mahoney Lake water collected from different depths and at different times. Comparisons were made between conductivity determined from in situ measurements, conductivity in diluted water, made between conductivity determined from in situ measurements, conductivity in diluted water, and chemical analysis. Conductivity measurements were evaluated as estimates of the dissolved solids content of the water. T-C relationships changed considerably with depth and season in salt-stratified lakes, and errors as high as 15% could occur in Mahoney Lake unless several T-C plots were used to adjust field conductivity measurements to a constant temperature. Corrected in situ measurements underestimated conductivity as determined from the chemical composition. Diluted conductivity provided a more consistent estimate of distributions. ity provided a more consistent estimate of dis-solved solids content by eliminating most effects of ion-ion interactions upon ion mobility. (Alexander-PTT) W87-05051

SEQUENTIAL TESTS FOR INFECTIOUS HE-MATOPOIETIC NECROSIS VIRUS IN INDI-VIDUALS AND POPULATIONS OF SOCKEYE VIDUALS AND POPULATIONS OF SOCKEYE SALLMON ONNOCRHYNCHUS NERKA), Seattle National Fishery Research Center, WA. D. M. Mulcahy, and R. J. Pascho.
Canadian Journal of Fisheries and Aquatic Sciences CIFSDX, Vol. 43, No. 12, p 2515-2519, December 1986. 2 fig. 3 tab, 10 ref.

Descriptors: *Testing procedures, *Salmon, *Viruses, *Fish diseases, Spawning, Reproduction, Tissue analysis, Fish hatcheries, Pollutant identification, Fish populations, Sockeye Salmon.

identification, Fish populations, Sockeye Salmon. Infectious hematopoietic necrosis (IHN) is an acuterhabdoviral disease of salmonid fishes characterized by a putative lifelong latent infection with virus production only at the extremes of the host's life cycle. The appearance of the virus in fish as they spawn would permit its vertical transmission. Efforts to control loses of hatchery fish due to HIN depend on the testing of populations by examination of spawning adults to detect the virus and ensure the use of virus-free eggs for production fish. Existing protocols describe acceptable laboratory procedures for the examination of samples for the detection of HIN virus in cavity fluid from spent female sockeye salmon (Oncorhynchus nerka) varied little when fish from a naturally spawning population were sampled three times on alternate days. However, when prespawning female sockeye salmon from a second population were individually tagged, penned, and sampled daily, the incidence and proportion of fish with high virus titer rose over a 6-d period. In 10 instances, consecutive cavity fluid samples from the same fish reverted from virus-positive to virus-negative. It is suggested that spent fish should be sampled when accurate and quantitative data on the incidence and level of the virus are required. (Alexander-PTT)

W87-05055

GASEOUS BEHAVIOR OF TCE OVERLYING A CONTAMINATED AQUIFER,
For primary bibliographic entry see Field 5B.
W87-05064

SINGLE WELL MEASUREMENTS AS A TOOL FOR DECONTAMINATION OF AN ARSENIC CONTAMINATED GROUNDWATER PLUME, Kiel Univ. (Germany, F.R.). Geologisch-Palacontologisches Inst. und Museum. For primary bibliographic entry see Field 5B. W87-05123

HYDROGEOCHEMISTRY OF GROUNDWAT-FR IN THE DELHI REGION OF INDIA,
Jawaharlal Nehru Univ., New Delhi (India).
School of Environmental Sciences.
For primary bibliographic entry see Field 2F.
W87-05127

PETROLEUM HYDROCARBONS AND OR-GANIC CHEMICALS IN GROUND WATER -PREVENTION, DETECTION AND RESTORA-TION - A CONFERENCE AND EXPOSITION, National Water Well Association, Worthington,

For primary bibliographic entry see Field 5G. W87-05128

MIGRATION AND APPARENT SUBSURFACE BIODEGRADATION OF ORGANIC COM-POUNDS IN A FRACTURED BEDROCK AQUI-

Dames and Moore, Cranford, NJ. For primary bibliographic entry see Field 5B. W87-05134

FIELD SCREENING FOR ORGANIC CON-TAMINANTS IN SAMPLES FROM HAZARD-OUS WASTE SITES, NUS Corp., Gaithersburg, MD. H. K. Roffman, M. D. Neptune, J. W. Harris, A. Carter, and T. Thomas.

Carter, and T. Thomas.

IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 236-243, 1 tab.

Descriptors: *Field screening, *Organic compounds, *Hazardous wastes, *Disposal sites, *Water quality control, Groundwater quality, Monitoring, Costs, Cost analysis, Chemical analy-

Field screening of environmental samples is an important mechanism for focusing the samples requiring costly and time-consuming central laboratory analyses. Screening also allows for selecting more suitable and representative samples for laboratory analyses. Field screening is a tool that utilizes analytical chemistry at or near the worksite to rapidly determine the presence of environmental contaminants and their approximate concentration. These data may be generated in a pear real-time rapidly determine the presence of environmental contaminants and their approximate concentration. These data may be generated in a near real-time mode and used to influence both central laboratory sample selection decisions and site study decisions such as drilling locations and extent of contamination. Samples selected for full laboratory analyses are sent to the laboratory after the screening phase. This phased approach has four benefits: (1) reduces costs, (2) allows collection of samples that are representative of site problems and analysis of such samples at central laboratories, (3) provides sufficient testing to characterize the contents of the waste for some regulatory requirements, and (4) provides sufficient data for the preparation of a hazardous waste management plan. The field screening approach discussed in this paper has been developed and implemented on several Superfund hazardous waste ists in Michigan. (See also W87-05128) (Author's abstract) W87-05144

MONITORING OF UNDERGROUND STOR-AGE TANKS: CURRENT TECHNOLOGY, AGE TANKS: CURRENT TECHNOLOGY, Weston (Roy F.), Inc., West Chester, PA. R. A. Scheinfeld, and T. G. Schwendeman. IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 244-264, 10 fig. 1 ref.

Descriptors: *Monitoring, *Path of pollutants, *Underground storage, *Storage tanks, *Technology, Groundwater quality, Water quality control, Water pollution prevention, Thermal conductivity, Resistivity, Solubility, Permeability.

The current regulatory climate with respect to underground petroleum storage tanks is one in which a growing number of state and local governments have mandated the use of leak detection systems. This has resulted in a confusing array of hydrocarbon detection devices currently being offered to perform this type of function. These systems, installed in vapor well, observation wells or U-tubes include: thermal conductivity sensors, electrical resistivity sensors, product soluble devices, interface tapes, product permeable materials and vapor detectors. It is important to note that many of these leak detection devices have limited operational field experience. It is therefore important, when evaluating detection devices to consider efficiency, durability and cost, as well as the regutant, when evaluating detection devices to consider efficiency, durability and cost, as well as the regulatory requirements of the region. A well thoughtout leak detection system will provide a storage facility owner with the most effective system to address site specific conditions. Most importantly, the correctly chosen and installed detector will help limit the potential financial liability that could result from a leaking underground storage system. (See also W87-05128) (Lantz-PTT)

DEFINING EXTENT OF CONTAMINATION USING ONSITE ANALYTICAL METHODS, Wooster Community Hospital, OH. For primary bibliographic entry see Field 5B. W87-05148

CASE HISTORY: SURFACE STATIC COLLEC-TION AND ANALYSIS OF CHLORINATED HYDROCARBONS FROM CONTAMINATED

GROUND WATER,
Petrex, Golden, CO.
M. J. Malley, W. W. Bath, and L. H. Bongers.
IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and
Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston,
Texas. 1986. p 276-290, 8 fig, 7 ref.

Descriptors: *Case studies, *Chemical analysis, *Groundwater pollution, *Chlorinated hydrocarbons, Path of pollutants, Fate of pollutants, Volatile organic compounds, Trichloroethylene, Trichloroethane, Monitoring.

A direct method for trapping and detecting volatile organic compounds (VOC's) emanating from contaminated groundwater has been successfully demonstrated. The method consists of a static trapping device which is placed just below the soil surface and left in the ground for seven to thirty days to ensure time-integrated collection of gas flux data. Analysis of the trapped compounds is performed by Curie point desorption mass spectrometry. Results of a soil gas survey conducted at a Denver industrial site demonstrates that the technique is a powerful tool for delineating subsurface contamination. Shallow groundwater in the study area exhibited trace concentrations of trichloroethylene (TCE) and trichloroethane (TCA) in highly localized flow zones. In areas of extensive hydrogeologic control, there is good correlation between surface flux data and contaminant levels in groundwater. The study also shows the technique is useful for inferring the extent and apparent direction of contamination where limited hydrogeologic data exists. Several monitoring wells drilled on Petrex anomalies encountered TCE and TCA contamina-

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tion in groundwater. Where soil gas studies are applicable, a static collection survey can provide a cost effective means for determining the extent of contamination over large areas. It can also provide a basis for remedial action and reduce overall designs of the property supplementations of the property supplementation. contamination over large areas. It can also provide a basis for remedial action and reduce overall exploratory costs when properly supplemented with conventional drilling and sampling programs. (See also W87-05128) (Author's abstract) W87-05147

USE OF SOIL GAS SAMPLING TECHNIQUES FOR ASSESSMENT OF GROUND WATER CONTAMINATION,

Warzyn Engineering, Inc., Madison, WI. S. G. Wittmann, K. J. Quinn, and R. D. Lee. IN: Petroleum Hydrocarbons and Organic Chem-cals in Ground Water - Prevention, Detection an can in Ground water - Freemon, Deceasion and Restoration - A Conference and Exposition, Pro-ceedings of the NWWA/API Conference, Novem-ber 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 291-309, 12 fig. 2 tab, 6 ref.

Descriptors: *Groundwater pollution, *Soil gas ampling, *Monitoring, Path of pollutants, Chemical analysis, Municipal water, Volatile organic compounds, Water pollution sources, Fate of pollutants, Vertical flow.

Preliminary results of a 1984 U.S. EPA Superfund Remedial Investigation (RI) of a contaminated municipal field identified multiple contaminant source areas with volatile organic compounds (VOCs). An inferred contaminant source, which had not been confirmed by prior direct sampling, was also detected. Shallow soil gas sampling was conducted to identify the migration route from one of the known contaminant sources and to screen a large railroad marshaling yard for possible source areas. Soil gas sampling was successful in identifying a contaminant migration route, and a small, significant source are in the railroad marshaling yard. Due to the strong downward vertical flow into the well field; however, this method did not enable mapping the plume from the railroad yard source into the well field. (See also W87-05128) (Author's abstract)

ELECTROMAGNETIC MEASUREMENTS FOR SUBSURFACE HYDROCARBON INVESTIGA-

Camp, Dresser and McKee, Inc., Annandale, VA. For primary bibliographic entry see Field 5B. W87-05149

NEW GROUND WATER SURVEY TOOL: THE COMBINED CONE PENETROMETER/ VADOSE ZONE VAPOR PROBE, McClelland Engineers, Inc., Houston, TX. For primary bibliographic entry see Field 5B.

INTERPRETATION OF GAS CHROMATOG-RAPHY DATA AS A TOOL IN SUBSURFACE HYDROCARBON INVESTIGATIONS, Amoco Corp., Tulsa, OK. For primary bibliographic entry see Field 5B.

5B. Sources Of Pollution

LEACHING OF PHENOLIC COMPOUNDS FROM LEAF AND NEEDLE LITTER OF SEV-ERAL DECIDUOUS AND CONIFEROUS

Vrije Univ., Amsterdam (Netherlands). Biological Lab. A. T. Kuiters, and H. M. Sarink. Soil Biology and Biochemistry SBIOAH, Vol. 18, No. 5, p 475-480, 1986. 1 fig. 1 tab, 41 ref.

Descriptors: "Water pollution sources, "Path of pollutants, "Deciduos trees, "Coniferous trees, "Phenolic compounds, "Leaching, "Leaves, "Needles, "Forest litter, Soil water, Beech, Birch, Oak, Ash, Maple, Spruce-fir, Douglas-fir, Larch, Pine, Hazelnut, Willow, Poplar, Gas chromstography,

namic acids, Organic compounds, Chromatog-

raphy.

Leaf and needle litter of deciduous trees (beech, birch, oak, ash, maple, hornbeam, hazelnut, willow, poplar, hawthorn) and coniferous trees (pine, spruce-fit, douglas-fit, larch) were collected immediately after "leaf-fall" in October and analyzed for their water-soluble phenolic constituents. Three collections of leaf and needle litter from October to January were used to determine leaching rates of these organic compounds. There were considerable differences in the amount and leaching rate of water-soluble phenolics between litter types. The concentrations in freahly-deposited leaves of deciduous species were high and most of the water-soluble phenolics were released during the period from October to January. In needle litters concentrations of water-soluble phenolic were low and they leached at a slow rate. By using gas chromatography, 14-18 phenolic compounds could be identified in the leachates. Benzoic acids dominated the phenolic spectra in October. In the course of time, cinnamic acids became more important in the water-leachates. (Author's abstract) W87-04365

ACID RAIN SPURS CLEAN-COAL RESEARCH, K. Brooks, and H. Bradford. Chemical Week CHWKA9, Vol. 139, No. 20, p 40-41, November 12, 1986.

Descriptors: *Water pollution sources, *Pollution control, *Air pollution control, *Acid rain, *Nitrogen oxides, *Sulfur oxides, Electrostatic fields, Membranes, Fluidized-bed combustion, Legisla-

Several Department of Energy-funded projects re-lated to burning coal more cleanly are discussed. These are: three NOx-removal projects employing 'reburning'; evaluation of NOx-reduction catalysts with intense electrostatic fields; membranes for separation of SOx and NOx; a ceramic cell soaked in electrically-conductive fluid to separate NOx and SOx; separation of SOx and NOx in and elec-trically-conductive porous foam; investigation of pollutant movement through membranes; retrofit of existing pulverized coal-fired boils with fluid-ized beds; modification of boilers to burn fuels of varying grades while minimizing effects on output and efficiency. The authors comment that im-provements in coal-burning technology have not reduced the controversy over acid rain. Although the year's big acid rain bill (H.R. 4567) made no progress, further measures can be expected to be introduced in the next Congress. (Rochester-PTT) W87-04371 W87-04371

ANION EXCLUSION DURING TRANSPORT THROUGH THE UNSATURATED ZONE, Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
For primary bibliographic entry see Field 2G.
W87-04399

AMINO ACIDS UPTAKE OF OSCILLATORIA RUBESCENS D. C. (BLUE GREEN ALGAE) (AS-SIMILATION DES ACIDES AMINES PAR OS-CILLATORIA RUBESCENS D. C. (CYANOPHY-

CEE), Institut National de la Recherche Agronomique, Thonon-les-Bains (France). Inst. de Limonologie. M. Feuillade, and H. Krupka. Archiv fuer Hydrobiologie AHYBA4, Vol. 107, No. 4, p 441-463, October 1986. 7 fig, 6 tab, 71 ref.

Descriptors: *Amino acids, *Isotpe studies, *Nutrients, *Growth rates, *Eutrophication *Limnology, *Algae, *Cyanophyta, *Metabolism, *Assimilation rate, Nitrogen, Liquid scintillation counting, Thinlayer autoradiochromatography, Proteins, Ammoning salth-Accumulation

m salts. Accumulation

A determination of whether blue-green algae from eutrophic lakes, Oscillatoria rubescens D. C., is able to take up amino acids as a nitrogen source is presented. A mixture of C14 amino acids was supplied to axenic strain of O. rubescens. Incorpo-ration into algal cells was followed by liquid scin-

tillation counting and disappearance of each acid from the medium by thin-layer autoradiochromatography. Amino acids were taken up in the light as in the dark at natural low concentration (0.2 microgram-at N/1) and rapidly metabolized into proteins, assimilation rate (microgram-at N-NH2/microgram-at N/1h) increased slightly when the nitrogen cell quota decreased. Uptake also occurred in the presence of ammonium salta. Assimilation rate encountered at amino acid natural low concentrations (1 microgram-at N/1) may support low growth rate (generation time: 14 days). Uptake systems of O. rubescens had high affinities for amino acids (Ks = 0.6 microM), especially for glycine and serine, which were generally the dominant amino acids in lake water. This suggests efficient competition abilities in natural water, for O. rubescens facing bacteria in presence of dissolved amino acids. The ecological contribution of amino acids may be important as a nitrogen source in conditions where nitrogen is low. (Author's abstract) stract) W87-04407

PHYTOPLANKTON GROWTH AND PHOS-PHATE UPTAKE (FOR P LIMITATION) BY NATURAL PHYTOPLANKTON POPULA-TIONS FROM THE LOOSDRECHT LAKES (THE NETHERLANDS), Amsterdam Univ. (Netherlands). Lab. voor Micro-biologie. R. Riegman, and L. R. Mur.

R. Riegman, and L. R. Mur. Limnology and Oceanography LIOCAH, Vol. 31, No. 5, p 983-988, September 1986. 5 fig, 23 ref.

Descriptors: "Phytoplankton, "Bioaccumulation "Phosphates, "Phosphorus removal, "Bioindicators, "Fate of pollutants, Lakes, Growth, Seasona variation, Prediction, Pollution load, Biomass

Algae bioassays can provide valuable information relevant to the understanding and prediction of the effects of nutrient additions or removal (e.g. by sewage_addition or diversion of diluted water) on errects of nutrient additions or removal (e.g. by sewage addition or diversion of diluted water) on lakes. Phosphate uptake capacity of natural phytoplantton populations was used as a physiological indicator of P limitation in the Loosdrecht lakes. During a substantial period of the growth season of 1983, P-limited growth was observed in Lake Breukeleveen and Lake Loosdrecht, but P limitation was less severe in the latter. In Lake Breukeleveen the maximum initial phosphate uptake rate (V sub m) varied between 0.3 and 5.7 microgram(ug) P/(ug Chl)/h during P-limited growth, whereas in Lake Loosdrecht, V sub m varied between 0.3 and 2.1 ug P/(ug Chl)/h. Both at the end of June and the beginning of July, growth was not P limited in either lake. Phytoplantton in Lake Loosdrecht was not limited by phosphorus in September. The frequent occurrence of P limitation led to the prediction that reduction of the P loadings of Lake Loosdrecht will result in a reduction of the phytoplankton biomass. (Alexander-PTT)

FALLOUT PLUTONIUM IN TWO OXIC-ANOXIC ENVIRONMENTS, Washington Univ., Seattle. School of Oceanogra-

phy. A. L. Sanchez, J. W. Murray, W. R. Schell, and L. G. Miller.

Limnology and Oceanography LIOCAH, Vol. 31, No. 5, p 1110-1121, September 1986. 5 fig, 3 tab, 51

Descriptors: *Pallout, *Plutonium, *Anoxic water, *Path of pollutants, Saanich Inlet, Particulate matter, Concentration, Oxides, Lakes, Alkalinity, Salinity, Dissolved solids, Monimolimnion, Sulfides, Dissolved oxygen, Chemical properties.

Dissolved plutonium (Pu) has been measured in several marine, estuarine, and freshwaters, but there have been few studies of its distribution in anoxic systems. The profiles of soluble fallout plutonium in two partially anoxic waters revealed minimum concentrations at the O2-HZS interface, indicating Pu removal onto particulate phases of Fe and other oxidized species that form during the redox cycle. In Saanich Inlet, an intermittently

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anoxic fjord in Vancouver Island, Canada, the concentration of soluble Pu in the anoxic zone was anoxic fjord in Vancouver Island, Canada, the concentration of soluble Pu in the anoxic zone was slightly less than in the oxygenated surface layer. In Soap Lake, a saline meromictic lake in eastern Washington State, Pu concentrations in the permanently anoxic zone were at least an order of magnitude higher than at the surface. Differences in the chemical characteristics of these two waters suggest important chemical species that influenced the observed Pu distribution. In the permanently anoxic zone of Soap Lake, high values of total alkalinity ranging from 940 to 1,500 meq/liter, sulfide species from 38 to 128 microM, dissolved organic carbon from 163 to 237 mg/liter, and total dissolved solids from 80 to 140 ppt, all correlated with the observed high concentration of Pu. In Saanich Inlet, where total alkalinity ranged from 2.1 to 2.4 meq/liter and salinity from 2.5 to 3.2% and H2S concentration in May 1981 showed a maximum of 8 microM, the observed Pu concentrations were significantly lower than for the Soap Lake monimolimnion. (Alexander-PTT)

FILTERING ACTIVITY OF DAPHNIA IN LOW CONCENTRATIONS OF A PESTICIDE, Warsaw Univ. (Poland). Dept. of Hydrobiology. For primary bibliographic entry see Field 5C. W87-04435

EXTRACTABILITY AND PLANT AVAILABIL-ITY OF MOLYBDENUM FROM INORGANIC AND SEWAGE SLUDGE SOURCES, Ohio State Univ., Columbus. G. M. Pierzynski, and L. W. Jacobs. Journal of Environmental Quality JEVQAA, Vol. 15, No. 4, p 323-326, October-December 1986. 5 tab, 12 ref.

Descriptors: *Extraction, *Plant availability, *Molybdenum, *Sludge, *Accumulation, *Path of pollutants, *Waste disposal, *Land disposal, *Heavy metals, Loam, Soil properties, Concentration, Corn, Soybeans, Alfalfa, Field tests, Performance evaluation, Tissue analysis, Crops, Regression analysis, Agriculture, Cultivation.

ysis, Agriculture, Cultivation.

Accumulation of heavy metals is a principal concern with the land application of sewage sludges or other wastes. Little information is in the literature regarding Mo accumulation in the soil from sludge additions. The primary hazard of soil contamination with Mo is the potential for producing forages that would contain high Mo levels and induce molybdenosis in ruminants. A greenhouse experiment was conducted to evaluate the influence of soil pH on the plant uptake and extractability of Mo applied to a soil as an inorganic salt and as a Mo-enriched sewage sludge. Molybdenum additions of 30, 60, and 120 mg/kg soil from Na2MoO42H2O and 20, 44, and 94 mg/kg soil from Anamerobically digested sewage sludge significantly increased Mo concentrations in con (Zea mays L.), soybeans (Glycine max(L.)Merr.), and alfalfa (Medicago sativa L.) grown on a sandy loam soil. Increases in soil pH significantly increased Mo accumulation in the three crops from both Mo sources Molybdenum extracted with Tamm's acid ammonium oxalate was not significantly influenced by soil pH white Mo extraction. toam soil. Increases in soil pH significantly increased Mo accumulation in the three crops from both Mo sources. Molybdenum extracted with Tsmm's acid ammonium oxalate was not significantly influenced by soil pH, while Mo extracted from sludge treated soils with the ammonium bicarbonate-DTPA (AB-DTPA) extractant was significantly increased with increasing soil pH. Multiple regressions between Mo concentrations in the crops and extractable Mo and soil pH indicated that soil pH was a significant variable in 17 of 24 prediction equations. The AB-DTPA extractant was more effective in predicting Mo concentrations in plant tissue than Tamm's acid ammonium oxalate with sludge Mo additions and is more effective with sludge source Mo as compared to inorganic source Mo. Whether AB-DTPA will predict Mo uptake by plants grown on soils receiving Mo additions needs to be tested by field evaluation with a large number of soil types. (Alexander-PTT) PTT) W87-0444

SOIL AND GROUNDWATER SALINITY ALONG DRAINAGE DITCHES IN EASTERN NORTH DAKOTA

North Dakota State Univ., Fargo. Dept. of Soil Science.
For primary bibliographic entry see Field 4C.
W87-04445

MOLYBDENUM ACCUMULATION BY CORN AND SOYBEANS FROM A MOLYBDENUM-RICH SEWAGE SLUDGE,

Ohio State Univ., Columbus.

G. M. Pierzynski, and L. W. Jacobs.

Journal of Environmental Quality JEVQAA, Vol.

15, No. 4, p 394-398, October-December 1986. 6

tab, 22 ref.

Descriptors: *Bioaccumulation, *Sludge, *Water pollution effects, *Path of pollutants, *Waste disposal, *Land disposal, *Molybdenum, *Corn, *Soybeans, Digested sludge, Tissue analysis, Heavy metals, Concentration, Soil analysis, Field tests, Nutrients, Extraction, Spectral analysis.

Land application of sewage sludges is an attractive waste management alternative for many munici-palities. The accumulation of heavy metals in the soil has long been recognized as one of the main concerns with this option. The metals tryically studied are Zn, Cu, Cr, Cd, Ni, or Pb with little information in the literature about Mo. An anerobically digested sewage studge containing 1500 mg Mo/kg was applied to add 0 to 300 kg Mo/ha in two separate experiments. This field study was conducted with corn (Zea mays L.) and soybeans (Glycine max(L.) Merr.) over a 3-yr-period to evaluate high Mo additions to soils from the application of Mo-concentration wastes. A total Mo cation of Mo-concentration wastes. A total Mo-nalysis of soils sampled after the third growing season accounted for 97% of the applied Mo in two sludge treatments. Concentrations of Mo in whole plant, diagnostic tissue, and grain samples from both crops were significantly increased with any sludge treatment. Lime residues in the sludge increased soil pH's from 4.8 to 7.1 resulting in further Mo accumulation in the plant samplings. Four soil extractants (1.0 M NH4HCO3 + 0.005 M DTPA, 1.2 M NaC2H3O2, Tamm's acid ammo-nium oxalate, and 0.5 M (NH4)2HPO4) in combi-nation with soil pH were evaluated for their ability to predict Mo concentrations in the plant samnation with soil pri were evaluated for their ability to predict Mo concentrations in the plant samplings. Soil pH became significant in the prediction equations when considering more than 1 yr of data. None of the extractants were proven to be clearly better or worse than the others. Further testing of the ammonium bicarbonate-DTPA extractant is the ammonium ocaroonate-DIFA extractant is recommended because of its potential for simultaneous use with other plant nutrients and heavy metals in the soil during multielement analysis, as well as the ease by which it can be analyzed using plasma emission. (Alexander-PTT)

PLANT AVAILABILITY OF PHOSPHORUS IN SEWAGE SLUDGE COMPOST,

Maryland Univ., College Park.

J. L. Mccoy, L. J. Sikora, and R. R. Weil.

Journal of Environmental Quality JEVQAA, Vol.

15, No. 4, p 403-409, October-December 1986. 3

fig, 10 tab, 30 ref.

Descriptors: *Sludge, *Path of pollutants, *Composted sludge, *Phosphorus, *Fate of pollutants, *Waste disposal, *Land disposal, *Nutrients, Compost, Field tests, Performance evaluation, Loam, Clays, Accumulation, Tissue analysis, Yield, Plant growth, Corn, Extraction.

In a survey of sewage sludge from eight states it was reported that the mean total N and P contents were 3.3 and 2.3%, respectively. Because the crop requirement for P is usually 1/10th to 1/5th that for N, excessive quantities of P are applied when sewage sludge products are used to supply the N requirement of the crop. Field and greenhouse studies were conducted to compare the effectiveness of Blue Plains sewage sludge compost (BLU), Parkway sewage sludge compost (PAR), and triple superphosphate (TSP) as sources of P for corn. These amendments were applied to a Sassafras sandy loam (Typic Hapludulta) in a field study and to the Sassafras soil and a Christiana silty clay loam (Typic Paleudulta) in a greenhouse study. First-year application rates in the field study

ranged from 0 to 1500 kg total P/ha. Plots were split the second year with one-half receiving no additional P and one-half receiving P equal to 1st-yr rates. Nitrogen as NH4N03 was applied at variable rates to plots so that the total assumed available N equaled 180 and 219 kg N/ha for the variance rates to piots so that the total assumed ravailable N equaled 180 and 219 kg N/ha for the 1st and 2nd yr, respectively. Dry matter yield and P uptake were measured at the eight-leaf stage (V8) and at maturity. Below the 100 kg P/ha rate, TSP but not the composts, significantly increased growth and P uptake by corn in both field and greenhouse studies. The TSP was approximately four to seven times more effective than either compost in raising tissue P concentration in corn (Zea mays L) ear leaves. A maximum of 2.05 and 11.2% of the P applied as compost and TSP, respectively, was taken up by the corn. Soil P extracted by the dilute double acid (0.5 M HCl and 0.0125 M H2SO4) and 0.5 M NaHCO3 methods increased with increasing P application from all 0.0125 M FL2SO4) and 0.3 M Nath Co methods increased with increasing P application from all sources. Extractable soil P by both methods correlated well with total P uptake from TSP but did not correlate well with P uptake from the composts. A P fractionation indicated that most of the compost P was associated with Fe and Al and only process. compost P was associated with Fe and Al and only 2 to 5% was in organic forms. The Fe-bound P fraction of the amended soils increased with increasing P application from all sources. Two factors appeared to control the P uptake response of corn: the treatment of the wastewater to remove P at the sewage treatment plant, and the P fixing capacity of the soil. (Alexander-PTT) W87-04451

DENITRIFICATION IN MARL AND PEAT SEDIMENTS IN THE FLORIDA EVER-

GLADES, Old Dominion Univ., Norfolk, VA. Dept. of Bio-For primary bibliographic entry see Field 2H. W87-04458

FORMATION OF METHANE AND CARBON DIOXIDE FROM DIMETHYLSELENIDE IN ANOXIC SEDIMENTS AND BY A METHANOGENIC BACTERIUM, Geological Survey, Menlo Park, CA. Water Resources Div

sources Div.

sources LIV.

R. S. Oremland, and J. P. Zehr.

Applied and Environmental Microbiology
AEMIDF, Vol. 52, No. 5, p 1031-1036, November
1986. 3 fig, 1 tab, 23 ref.

Descriptors: "Fate of pollutants, "Path of pollutants, "Dimethylselenide, "Carbon dioxide, "Methane bacteria, "Anoxic sediments, "Water pollution sources, "Methane, "Sediments, "Isotope studies, Metabolism, Selenium, Heavy metals, Inhibition, Enzymes, San Francisco Bay, Bacteria, Biodegra-

The reported toxic effects of elevated levels of selenium in agricultural wastewaters on waterfowl and fish populations in a marsh ecosystem have heightened the need to understand the biogeochemistry of selenium in anoxic environments. It has been hypothesized that methylation reactions may provide a mechanism whereby certain microbes (as well as plants and animals) 'detoxify' both their tissues and aurroundings by producing DMSe and well as plants and animals) 'detoxify' both their tissues and surroundings by producing DMSe and 'venting' it to the atmosphere. DMSe may constitute a portion of the total vapor-phase selenium found in the atmosphere. Although various aerobic soil microorganisms can produce DMSe from added organic or inorganic forms of selenium few studies have investigated the formation and fate of DMSe under anaerobic conditions. Anaerobic San Exercise Days est mesh sediments can idle to the product of the prod DMSe under anaeronic conditions. Anaeronic sain Francisco Bay salt marsh sediments rapidly metab-olized (14C)dimethylselenide(DMSe) to 14CH4 and 14CO2. Addition of selective inhibitors (2-bromoethanesulfonic acid or molybdate) to these sediments indicated that both methanogenic and sulfate-respiring bacteria could degrade DMSe to sulfate-respiring bacteria could degrade DMSe to gaseous products. However, sediments taken from the selenium-contaminated Kesterson Wildlife Refuge produced only 14CO2 from (14C)DMSe, implying that methanogens were not important in the Kesterson samples. A pure culture of a dimethylsulfide (DMS)-grown methylotrophic methanogen converted (14C)DMSe to 14CH4 and 14CO2. However, the organism could not grow on DMSe.

Sources Of Pollution—Group 5B

Addition of DMS to either sediments or the pure culture retarded the metabolism of DMSe. This effect appeared to be caused by competitive inhibition, thereby indicating a common enzyme system for DMS and DMSe metabolism. DMSe appears to be degraded as part of the DMS pool present in anoxic environments. These results suggest that methylotrophic methanogens may demethylate methylated forms of other metals and metalloids found in nature. (Alexander-PTT) W87-04460

BACTERIAL COMMUNITIES DEGRADING AMINO- AND HYDROXYNAPHTHALENE-2-SULFONATES, Gesamthochschule Wuppertal (Germany, F.R.). Lehrstuhl fuer Chemische Mikrogiologie. B. Nortemann, J. Baumgarten, H. G. Rast, and H.-I. K. Chemische

Applied and Environmental Microbiology AEMIDF, Vol. 52, No. 5, p 1195-1202, November 1986. 7 fig. 1 tab, 14 ref. AIF Grant 6279, Bundes-minister fur Forschung und Technologie Grant

Descriptors: *Biodegradation, *Sulfonates, *Bacteria, *Water pollution sources, *Fate of pollutants, *Metabolism, River Elbe, Organic compounds, Cultures, Isolation, Oxidation, Accumulation,

Amino- and hydroxynaphthalenesulfonic acids(ANSs and HNSs) are important building blocks for the large-scale synthesis of azo dyes. The amino and hydroxy substituents are indispensable as auxochromic groups, while the water solublity of this class of reactive dyes is essentially based on the sulfonic acid group. Since arylsulfonates are very rare among natural compounds, the sulfonic acid group confers a xenobiotic character to this class of chemicals. Consequently, unadapted microbial populations of activated sludge do not degrade sulfonated naphthalenes or degrade them incompletely. A 6-aminonaphthalene-2-sulfonic acid(6-ANS)-degrading mixed bacterial community was isolated from a sample of river Elbe water. The complete degradation of this xenobiotic compound may be described by a mutualistic interaction of two Pseudomonas strains isolated from this culture. One strain, BN6, could also grow on 64 aNS in proceedings. tion of two Pseudomonas strains isolated from this culture. One strain, BN6, could also grow on 6A2NS in monoculture, however, with accumulation of black polymers. This organism effected the initial conversion of 6A2NS into 5-aminosalicylate(5AS) through regioselective attack of the naphthalene skeleton in the 1,2-position. SAS was totally degraded by another member of the community, strain BN9. After prolonged adaptation of strain BN6 to growth on 6A2NS, this organism readily converted all naphthalene-2-sulfonates with OH- or NH2-substituents in the 5-6,7-, or 8-position. The corresponding hydroxy- or aminosalicylates were excreted in stoichiometric amounts, with the exception that the metabolite from 5A2NS oxidation was not identical with 6AS. (Alexander-PTT)

EMPIRICAL RELATION BETWEEN SUL-PHUR DIOXIDE EMISSIONS AND ACID DEP-OSITION DERIVED FROM MONTHLY DATA, Environmental Defense Fund, New York. For primary bibliographic entry see Field 2B.

UNRAVELLING A CENTURY OF ACID POL-LUTION,

New Scientist NWSCAL, Vol. 111, No. 1527, p 23-24, September 25, 1986.

Descriptors: *History, *Acid rain, *Air pollution, *Acidity, *Soil chemistry, *Public policy, Rainfall, Rivers, Toxicity, Lakes, Electric power production, Chemistry of precipitation, Trees, Forests, Sulfur, Nutrients, Nutrient removal, Aluminum.

Britain's Central Electricity Generating Board (CEGB) has admitted that it is partly to blame for the acid rain problem in Scandinavia. The crucial new evidence about acid rain relates to its effects

on soils. Acid rain has three main effects on soils. It fertilizes them via nitrogen and sulfur. Then it acidifies as the sulfate washes nutrients from the soil leaving behind hydrogen ions. Finally, it liberates toxic aluminum and hydrogen ions into streams. It is concluded that acid stored in soil streams. It is concluded that acid stored in soil over decades will continue polluting even if every power station were to be shut down immediately. Scandinavian lakes are being restored by application of limestone. Restoration of acidified soil might cost 15 billion pounds in West Germany alone. (Doria-PTT)
W87-04473

ACID RAIN: NEW FEARS PROMPTED CLEANUP,

F. Pearce. New Scientist NWSCAL, Vol. 111, No. 1526, p

Descriptors: *Air pollution control, *Acid rain, *Air pollution, *Sulfur dioxide, *Sulfu emissions, *Water pollution sources, *Britain, *Electric power production, *Public policy, Rainfall, Gypsum, Sulfur, Industrial wastes, Powerplants, *Administrict.*

Plans to cut Britain's contribution to Europe's acid rain may do little more than preserve the status quo. The Department of the Environment conquo. The Department of the Environment confirmed that it is not certain that the 600 million pounds to be spent by the Central Electricity Generating Board (CEGB) over the next decade will result in any further reduction in the nation's emissions of sulfur dioxide, which currently amount to 3.25 million tons per year, of which 70% comes from the CEGB's power plants. The program, which will not be complete until 1997, will reduce by 90% the emissions of sulfur from three of the CEGB's 12 large base-load coal-fired power plants. However, the CEGB could not confirm which plants would be fitted with cleanup equipment or which of the available technologies for flue-gas desulfurization would be used. Methods of flue-gas desulfurization are described. (Doria-PTT)

INVESTIGATIONS COMPARING THE INFLU-ENCE OF SPRUCE (PICEA ABIES (L.) KARST) AND BEECH (FAGUS SYLVATICA L.) ON THE QUALITY OF SEEPAGE WATER (VERGLEI-CHENDE UNTERSUCHUNGEN UEBER DEN EINFLUSS VON FICHTE (PICEA ABIES (L.)
KARST) UND BUCHE (FAGUS SYLVATICA L.)
AUF DIE SICKERWASSERQUALITAET),
Munich Univ. (Germany, F.R.). Lehrstuhl fuer Rodenkunde

Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 364-371, September 1986. 4 fig, 1 tab, 8 ref.

Descriptors: *Water pollution sources, *Water analysis, *Nutrients, *Spruce trees, *Beech trees, *Seepage, Hydrogen ion concentration, Nitrifica-

The objective of the investigation is to find out to what extent components of seepage water depend on the type of stocking. The investigation was performed on two pairs of stands of beech and Norway spruce. During one year in 3- to 5-week intervals seepage water was gathered with suction candles. At a depth of 40 cm the seepage water under the spruce trees was more acid and contained more nitrate, sulfate, calcium and magnesium than that under beech. At 175 cm the contents of protons, nitrate and sulfate were higher under spruce than under beech, and bicarbonate was found under beech as well. The differences in pH, nitrate and sulfate are mainly caused by a different filtering from the atmosphere and by a different nitrogen regime. Possibly high nitrification rates (exceeding requirement) lead to elevated proton production causing intensified mobilization of bases in the main root horizon. It seems to be important that under spruce higher ammonium input occurs besides intensified mineralization of nitrogen from humus, accumulated by broadleaf trees which were growing on this site before the establishment of spruce plantations. (Author's abstract)

W87-04510

MESOSCALE STORM AND DRY PERIOD PARAMETERS FROM HOURLY PRECIPITA-

TION DATA, Battelle Pacific Northwest Labs., Richland, WA. For primary bibliographic entry see Field 2B. W87-04512

TRAJECTORY ANALYSIS OF WET DEPOSITION AT WHITEFACE MOUNTAIN: A SENSI-

TION AT WHITEFACE MODIFIANTS A Constitution of the Administration, Rockville, MD. Air Resources Labs.

B. J. B. Stunder, J. L. Heffer, and U. Dayan.

Atmospheric Environment ATENBP, Vol. 20, No. 9, p 1691-1695, September 1986. 4 fig. 1 tab, 11 ref.

Descriptors: *Water pollution sources, *Weather data collections, *Model studies, *Precipitation, *Sulfates, *Acid rain, *Deposition, Whiteface Mountain, New York, Great Lakes, Pollutants, Air pollution, Fallout.

Meteorological trajectory analysis, MAP3S pre-cipitation chemistry data, and hourly precipitation data at Whiteface Mountain were used to deter-mine the direction of sulfate deposited in precipita-tion. A sensitivity study was done on source direc-tion from different trajectory models, using differ-ent transport layers, and different precipitation in formation to determine the time deposition oc-curred. Results obtained from the different precipi-tation information reveal that precipitation data. curred. Results obtained from the different precipitation information reveal that precipitation data in 6-h increments or less are essential to correctly identify the trajectories associated with the wet deposition. Bias resulted when trajectories were not only associated with wet deposition. The direction of source regions, defined by 30 degrees sectors, was much less dependent on the trajectory model or transport layer. Results suggest that over one-third of the wet sulfate deposition at White-face Mountain arrived from the west-southwest, passing through the eastern Great Lakes regions. (Author's abstract) W87-04513

ORGANIC ACIDS IN SPRINGTIME WISCON-SIN PRECIPITATION SAMPLES, Battelle Pacific Northwest Labs., Richland, WA. E. G. Chapman, D. S. Sklarew, and J. S.

Flickinger.
Atmospheric Environment ATENBP, Vol. 20, No. 9, p 1717-1725, September 1986. 6 tab, 24 ref.
Battelle, Pacific Northwest Labs Contract 2311204999.

Descriptors: "Water pollution sources, "Rainfall, "Organic acids, "Acid rain, "Deposition, Air pollution, Pollutants, Fallout, Acids, Wisconsin, Wisconsin Acid Deposition Monitoring Network, Sample preparation, Chromatography.

A short-term study on organic acids in precipita-tion was conducted at two sites on the Wisconsin Acid Deposition Monitoring Network. Aliquots of collected samples were fixed with tetrachloromer-curate and analyzed for low molecular weight organic anions via ion-exclusion chromasography. Unfixed aliquots were subjected to standard net-work inorganic analyses. Of the 31 samples collect-ed, 30 contained detectable concentrations of for-mate and acetate ions as well as propionate of mate and acetate ions, as well as propionate, oxa-late and malonate ions. Statistical analysis of the combined organic and inorganic data set indicated that no significant differences existed between the concentrations of organic ions at the two sites; however, samples containing visible sediments had nowever, samples containing visible sediments had significantly greater concentrations than samples without sediments. The study emphasizes the need for further, longer-term investigations to determine the role of low molecular weight organic com-pounds in precipitation chemistry. (Author's ab-stract) stract) W87-04514

FLUORIDE CYCLING IN NATURE THROUGH PRECIPITATION, Bhabha Atomic Research Centre, Bombay (India).

Group 5B-Sources Of Pollution

Air Monitoring Section.
T. N. Mahadevan, V. Meenakshy, and U. C. Mishra.

Atmospheric Environment ATENBP, Vol. 20, No. 9, p 1745-1749, September 1986. 3 fig. 2 tab, 16 ref.

Descriptors: *Water pollution sources, *Weather data collections, *Cycling, *Fluorides, *Precipitation, *Rainfall, Urban areas, Air pollution, India.

Some uncertainties still exist regarding the fluoride circulation in the atmosphere, and fluoride in pre-cipitation has served as a useful indicator in these assessments. Recent studies on fluoride measureassessments. Recent studies on fluoride measurement in precipitation from coastal and inland areas indicate that anthropogenic sources are the major contributors rather than preferential injection at the sir-sea interface. However, studies with samples collected from marine, coastal and inland sites in the Indian subcontinent reveal a definite contribution of fluoride from sea salt. The correlation bution of fluoride from sea salt. The correlation between F and Na follows the power law y = ax to the b power with similar alopes for all sites, excepting the urban sites where anthropogenic courses dominate. The study establishes a background fluoride concentration in precipitation in the range of 1-12 ppb, with a mean around 5 ppb. (Author's abstract)
W87-04515

MODEL OF SULPHATE PRODUCTION IN A CAP CLOUD AND SUBSEQUENT TURBU-LENT DEPOSITION ONTO THE HILL SUR-

University of Manches ter Inst. of Science and Oniversity of Manchester Inst. of Science and Technology (England). Dept. of Physics. T. A. Hill, T. W. Choularton, and S. A. Penkett. Atmospheric Environment ATEMPR, No. 20, Vol. 9, p 1763-1771, September 1986. 11 fig. 2 tab, 22 ref.

Descriptors: *Sulfates, *Model studies, *Water pollution sources, *Clouds, *Deposition, *Oxida-tion, *Acid rain, *Precipitation, *Rainfall, Fog, United Kingdom, Atmosphere, Wind, Wind veloc-ity, Velocity, Fallout.

ny, veiocity, Fallout.

A model was made of the dynamics and microphysics of a hill cap cloud. This was used to study the aqueous phase oxidation of SO2 in the cloud droplets and the subsequent turbulent deposition of chemical species onto the hill surface. It was considered that the dominant oxidant is H2O2 in these clouds and that therefore the process was probably oxidant limited. The amount of sulfate produced was comparable to that found in cloud condensation nuclei typically found over the United Kingdom and elsewhere away from strong local sources of sulfate second. Ammonia concentrations were important, because they altered the cloud water PH and hence the solubility of SO2. Turbulent or 'occult' deposition proved to be sensitive to wind speed, the stability profile of the atmosphere and to the surface roughness. In a supercritical flow regime the occult deposition was a maximum just on the lee of the hill. (Author's abstract)

MODELING OF THE 1900-1980 TREND OF PRECIPITATION ACIDITY AT HUBBARD BROOK, NEW HAMPSHIRE, Massachusetts Inst. of Tech., Cambridge. Energy

J. A. Fay, D. Golomb, and S. Kumar. Atmospheric Environment ATENBP, Vol. 20, No. 9, p 1825-1828, September 1986. 3 fig, 11 ref.

Descriptors: *Precipitation, *Model studies *Water pollution sources, *Weather data collections, *Acid rain, *Rainfall, Fallout, Sulfates, Aipollution, Nitrates, Hubbard Brook, New Hampshire, Atmosphere.

A trend analysis of acid concentration in precipita-tion is important to the understanding of the sur-face water acidification and other ecological eftace water acumcation and other econgical er-fects related to acid deposition. Because no accu-rate continuous monitoring was performed any-where prior to the past few decades, it was neces-sary to obtain a concentration trend from the known emission trend of acid deposition precur-

sors. Sulfate and nitrate concentrations in precipitation from 1900 to 1980 at Hubbard Brook, New Hampshire were modeled using constant meteorology but annually varying emission strength. The contribution of U.S. emissions to the annual avercontribution of U.S. emissions to the annual average SO4(2-) concentration increased steadily from 1900 to 1920, but remained somewhat constant thereafter. The estimated annual average pH of precipitation decreased from 4.7 in the beginning of the century to about 4.2 at present. These calculations are in good agreement with the measurements for the period 1964-1981. (Author's abstract) W87-04517

DETERMINATION OF TRACE METALS IN RAIN WATER BY DIFFERENTIAL-PULSE STRIPPING VOLTAMMETRY, Antwerp Univ., Wilrijk (Belgium). Dept. of Chem-

For primary bibliographic entry see Field 5A. W87-04518

ENZYME TEST FOR DETERMINING ISOMA-LATHION IMPURITIES IN WATER-DISPERS-IBLE POWDERS OF MALATHION, Yugoslav Academy of Sciences and Arts, Zagreb. Inst. for Medical Research and Occupational

Health. For primary bibliographic entry see Field 5A. W87-04520

LAKE RESOURCES AT RISK TO ACIDIC DEP-OSITION IN THE UPPER MIDWEST, Univ., Iowa City. Dept. of Civil and Envi-ental Engineering. Iowa Univ ronmental Engineering.

J. L. Schnoor, N. P. Nikolaidis, and G. E. Glass.

Journal - Water Pollution Control Federation

JWPFA5, Vol. 58, No. 2, p 139-148, February

1986. 13 fig. 5 tab, 26 ref. EPA Cooperative

Agreement CR-810395.

Descriptors: *Water pollution sources, *Acidic deposition, *Acid precipitation, *Lakes, *Rainfall, *Acid rain, Air pollution, Fallout.

A small fraction of lakes sampled in the Upper Midwest are presently acidic (0% in northern Min-nesota, 4% in north-central Wisconsin and about 19% in the eastern part of the Upper Peninsula of Michigan). According to field data and analysis, these lakes have been acidified by acid deposition for the following reasons: acid lakes are found only where there is significant acid precipitation across the depositional gradient; acid lakes are mainly (88%) seepage type lakes that receive most of their control of the control o to 70) seepage type takes that receive most of their water from precipitation falling directly on the surface of the lake and have no permanent inlets or outlets; sulfate is the dominant anion in precipitation and in the chemistry of these lakes; mass balance calculations at calibrated watersheds (Lake Valence and Lake Valence). Clara and Lake Vandercook) indicate that than 90% of hydrogen ions come directly from precipitation. (David-PTT)
W87-04530

DETERMINATION OF ORGANIC AND INOR-GANIC ACID SPECIES IN THE ATMOS-PHERE AND IN RAIN-WATER BY ION CHRO-

MATORGRAPHY,
Consiglio Nazionale delle Ricerche, Rome (Italy).
Ist. Inquinamento Atmosferico.
For primary bibliographic entry see Field 5A.
W87-04534

DETERMINATION OF NITRATE AND SUL-PHATE IN RAIN-WATER BY CAPILLARY ISOTACHOPHORESIS, Komenskeho Univ., Bratislava (Czechoslovakia). Inst. of Chemistry.

Inst. of Chemistry.
For primary bibliographic entry see Field 5A.
W87-04535

ASSOCIATION BETWEEN PCBS AND LOWER EMBRYONIC WEIGHT IN BLACK-CROWNED NIGHT HERONS IN SAN FRANCISCO BAY, Patuzent Wildlife Research Center, Laurel, MD. For primary bibliographic entry see Field 5C.

W87-04537

EVALUATION OF THE SIGNIFICANCE OF METAL-BINDING PROTEINS IN THE GASTROPOD LITTORINA LITTOREA, Marine Biological Association of the United Kingdom, Plymouth (England). For primary bibliographic entry see Field 5C. W87-04538

ALPINE TUNDRA SOIL BACTERIAL RE-SPONSES TO INCREASED SOIL LOADING RATES OF ACID PRECIPITATION, NITRATE, AND SULFATE, FRONT RANGE, COLORADO, U.S.A., Colorado Univ. at Boulder. Inst. of Arctic and Alpine Research.
For primary bibliographic entry see Field 5C.
W87-04551

DISPERSION IN ICE-COVERED LAKES, Uppsala Univ. (Sweden). Dept. of Hydrology. For primary bibliographic entry see Field 2H. W87-04554

LONGITUDINAL DISPERSION TESTS IN NON-UNIFORM POROUS MEDIA, Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
For primary bibliographic entry see Field 2G.
W87-04558

TRACERS OF SEWAGE SLUDGE IN THE MARINE ENVIRONMENT: A REVIEW, Lancaster Univ., Bailrigg (England). Lancashire and Western Sea Fisheries Joint Committee.

The Science of the Total Environment STENDL, Vol. 53, No. 1/2, p 5-40, August 1986. 5 tab, 276

Descriptors: *Wastewater treatment, *Path of pol-lutants, *Waste disposal, *Tracers, *Sludge, Re-views, Sludge distribution, Sediments, Pollutants, Organic wastes, Organic compounds, Isotopes, Mi-

A review of the available and potential tracers of the movement and distribution of sewage sludge ('sludge') in and on marine sediments was present-ed. A brief review of 'active' sludge tracers was ed. A brief review of 'active' sludge tracers was followed by a more extensive review of 'passive' aludge tracers. These could be broken down into five categories: (1) Natural organic components of sludge organic carbon, fecal steroids, carbohydrate/TOC ratio, tomato seeds; (2) Synthetic organic compounds - silicones, chlorinated hydrocarbons, non-ionic surfactants and their degradation products, linear alkylbenzenes; (3) Stable isotopes of carbon, nitrogen, hydrogen and sulfur; (4) Inorganic substances and their properties - minerals, paint pigments, trace elements, magnetic properties; (5) Biological/Microbiological - fecal bacteria, Clostridium welchii spores, amoebae, viruses, nipann pagmens, trace elements, magnetic properies; (5) Biological/Microbiological—fecal bacteria,
Clostridium welchii spores, amoebae, viruses, nitrogen-fixing enterobacteriacae. A wide variety of
sudge tracers are available with the choice of
suitable tracers in an individual situation governed
by the available equipment and expertise, cost considerations, ease of sampling requirements and determination, and the nature of other pollutan
inputs in the vicinity of the input of interest. Ideally, the sludge tracers chosen should be unique to
the input of interest, but this will rarely be achievable in practice. In areas of gross sludge contamination, a marine geophysical survey technique could
be used to delineate the area affected and this
provides a rapid cost-effective method for large
areas. (Author's abstract)
W87-04565

DISTRIBUTION OF CD, PB AND CU BE-TWEEN THE DISSOLVED AND PARTICU-LATE PHASE IN THE EASTERN SCHELDT AND WESTERN SCHELDT ESTUARY, Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Heisse Chemie.
P. Valenta, E. K. Duursma, A. G. A. Merks, H.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Sources Of Pollution-Group 5B

Rutzel, and H. W. Nurnberg.
The Science of the Total Environment STENDL,
Vol. 33, No. 1/2, p 41-76, August 1986. 16 fig. 11
tab, 48 ref. Commission of the European Communities Contract ENV-690-D.

Descriptors: *Path of pollutants, *Cadmium, *Lead, *Copper, *Estuaries, *Estuarine environment, *Dissolved solids, *Particulate matter, *Heavy metals, Costerscheldt estuary, Westerscheldt estuary, Salinity, Nutrients, Bioaccumula-

The distribution of the potentially ecotoxic heavy metals Cd, Pb and Cu between the dissolved and the particulate matter phase was studied in the Oosterscheldt and Westerscheldt estuaries, The Netherlands, in five missions during the spring, summer and winter of 1979-1980. In addition to the Netherlands, in five missions during the spring, summer and winter of 1979-1980. In addition to the metal concentration, other physical, chemical and biological parameters were determined, such as temperature, salinity, pH, particulate matter concentration, chlorophyll, dissolved organic carbon, particulate organic carbon and nutrients (phosphate, nitrate and silicate). The seasonal dependence due to the variable input of river water and biological activity was followed for all three metals studied. Cadmium preferred, in general, the dissolved phase but an unusually high Cd content in the particulate matter was found for the phytoplankton bloom period, which indicated an efficient uptake of Cd by living matter. Lead showed a pronounced preference for all types of particulate matter, whereas Cu tended, due to complexation with organic ligands, to approximately equal levels in the dissolved and particulate phases. The focal point of this study was the determination of the distribution of selected elements between the dissolved and the particulate phase, quantitatively described by the distribution coefficient K sub d. Its dependence on salinity and seasonal variation were also investigated. The mean value of K sub d. described by the distribution coefficient K sub d. Its dependence on salimity and seasonal variation were also investigated. The mean value of K sub d varied between 20 and 40 for Cd up to a maximum value of 70 during the phytoplankton bloom periods, between 40 and 140 for Cu and between 1000 and 3200 for Pb. The competition between complexation of heavy metals in the dissolved phase and their binding to particulate matter was also discussed. (Author's abstract)

ALPHA-EMITTING, HOT PARTICLES IN IRISH SEA SEDIMENTS, Ministry of Agriculture, Fisheries and Food, Lowestoft (England). Directorate of Fisheries Re-

P. J. Kershaw, J. H. Brealey, D. S. Woodhead, and M. B. Lovett.

M. B. Lovett.
The Science of the Total Environment STENDL,
Vol. 53, No. 1/2, p 77-87, August 1986. 6 fig, 1 tab,

Descriptors: "Water pollution sources, "Path of pollutants, "Industrial wastes, "Alpha-emitting particles, "Radioactive wastes, "Sediments, "Irish Sea, "Nuclear powerplants, "Fuel reprocessing, "Eff fluents, Radioactivity, Surface sediments, Transur-

Alpha-emitting, hot particles (HPs) were observed in samples of liquid effluent from the nuclear fuel reprocessing plant at Sellafield, U.K. Similar particles, thought to originate from Sellafield, were found in environmental samples from sites near the plant. The occurrence and distribution of hot particles in surface sediments from the northeastern sector of the Irish Sea were described and the implications for predicting transurantum element. sector of the Irish Sea were described and the implications for predicting transuranium element behavior were discussed. The distribution of HPs reflected that of the alpha-emitting transuranium radionuclides measured by conventional alpha-spectrometry. The proportion of alpha-activity associated with HPs did not diminish with distance from the pipeline discharge point and it was apparent that HPs persisted long enough to be redistributed throughout the region in a similar manner to the bulk of the Pu and Am discharged from Sellafield. More information was required on the vertical distribution of HPs in the biodistrubeds sediments to ascertain their susceptibility to degradaments of the Pu and Am discharged from Sellafield. cal distribution of HPs in the biodisturbed sedi-ments to ascertain their susceptibility to degrada-tion and the likelihood of their return to the sedi-ment surface. When obtained, such information

will feed models designed to predict the present and future consequences of the Sellafield dis-charges. (Wood-PTT) W87-04567

NITRATE LEACHING FROM A SMALL, UN-DERDRAINED, GRASSLAND, CLAY CATCH-

MENT, Oxford Univ. (England). Soil Science Lab. R. A. Haigh, and R. E. White. Soil Use and Management, Vol. 2, No. 2, p 65-70, June 1986. 2 fig, 2 tab, 26 ref.

Descriptors: *Water pollution sources, *Path of pollutants, *Nitrates, *Leaching, *Catchment areas, *Fertilizers, Clays, England, Grasalands, Tile drainage, Precipitation, Evapotranspiration, Drainage.

Losses of nitrogen in the tile drainflow from a clay soil (Evesham series) under grazed grassland were monitored during the 1982/83 and 1983/84 drainflow seasons. In 1982/83, 40% of the discharge had a NO3(-) concentration > 11.3 mg/l, while in 1983/84 concentrations were always > 20 mg/l. Total N lost by leaching was 17.5 and 48.7 kg/ha in 1982/83 and 1983/84 respectively, which was equivalent to 9 and 43% of the fertilizer applied. The marked difference in N losses for the two seasons was attributed to differences in the quantity and timing of N fertilizer applications, the dryness of the preceding summer and the duration and density of stocking. (Author's abstract) W87-04575

NICKEL-63 IN COLUMBIA RIVER SEDI-MENTS BELOW THE HANFORD RESERVA-

Oregon State Univ., Corvallis. School of Oceanography.

T. M. Beasley.

Journal of Environmental Radioactivity, Vol. 4,

No. 1, p 1-10, 1986. 1 fig, 2 tab, 20 ref.

Descriptors: *Path of pollutants, *Pollutant identification, *Nickel-63, *Sediments, *Columbia River, *Hanford Reservation, *Radionuclides, *Radioscotopes, *Radioactive wastes, *Rivers, Nuclear reactions, *Pathon Reserva topes, *Radioactive wastes, *Rivers, Nuttors, Isotopes, Decay constants, Surveys.

Nickel-63 (t sub 1/2 = 100y) was measured in Columbia River sediments below the Hanford Reservation. The present-day inventory between the confluence of the Snake and Columbia Rivers and the Columbia River mouth was estimated at near 4.6 TBq (approximately 125 Gi). Nickel-59 was not detected but, if present, the inventory of this long-lived radionuclide (t sub 1/2 = 75,000y) is probably less than 1% that of 63Ni. (Author's abstract) ably less the W87-04577

PLUTONIUM AND AMERICIUM IN ARCTIC WATERS, THE NORTH SEA AND SCOTTISH AND IRISH COASTAL ZONES, Lund Univ. (Sweden). Dept. of Radiation Physics. L. Hallstadius, A. Aarkrog, H. Dahlgaard, E. Holm, and S. Boelskifte. Journal of Environmental Radioactivity, Vol. 4, No. 1, p 11-30, 1986. 10 fig, 1 tab, 18 ref.

Descriptors: *Pollutant identification, *Fate of pol-Descriptors: Poliutant identification, "Fate of poliutants, "Part of poliutants, "Mater analysis, "Plutonium, "Americium, "Surface water, "Arctic waters, "Coastal waters, "Radioisotopes, "Radioactive wastes, North Sea, Greenland Sea, Barents Sea, Biota, Fallout, Isotopes, Radioactive decay, Effluents, Residence time.

Plutonium and americium were measured in surface waters of the Greenland and Barents Seas and in the northern North Sea from 1980 through 1984. Measurements in water and biota, Fucus, Mytilus and Patella, were carried out in North-English and Scottish waters in 1982 and Fucus samples were collected from the Irish coast in 1983. Fallout was found to dominate as a source of (239+240)Pu found to dominate as a source of (239+240)Pu north of latitude 65 deg N, while for 238Pu a substantial fraction originated from European nuclear fuel reprocessing facilities. The 238Pu/(239+240)Pu isotope ratio provided clear evidence

of the transport of effluent plutonium from the latter to Spitsbergen waters. Fallout plutonium in Arctic waters had a residence time of the order of several years, while for Pu from Sellafield we estimated mean residence times of 11-15 months in Scottish waters and, tentatively, 1.5-3y during transport from the North Channel (north of the Irish Sea) to Spitsbergen. 241Am found in Arctic waters probably originated from the decay of fallout 241Pu and, like Pu, tentatively had a residence time of the order of several years. Americium from time of the order of several years. Americium from Sellafield had an estimated mean residence time of 4-6 months in Scottish waters. (Author's abstract)

MIGRATION OF REACTOR-PRODUCED TRITIUM IN LAKE HURON, Helath and Welfare Canada, Ottawa (Ontario). En-ivronmental Radiation Hazards Div.

International Administration of Programme Prog

Descriptors: *Path of pollutants, *Water analysis, *Tritium, *Nuclear powerplants, *Lake Huron, *Radioisotopes, Heavy water, Transport, Calculations, Mathematical equations, Current velocity.

tions, Mathematical equations, Current velocity. Two exceptional releases of tritium from the Bruce Nuclear Power Development into Lake Huron occurred during September 1983. Although not of health significance, these releases gave an opportunity to study the transport of tritium in lake water near the reactor site. Water samples were collected daily during September and October from drinking water stations at Port Elgin, 20 km northeast of the site, and at Kincardine, 18 km southwest. Tritium was detected only at Port Elgin because of the general counter-clockwise circulation of the lake. The travel times of the tritiated water from each of the releases to Port Elgin were between two and four days. These lengths of time were in agreement with those calculated from the velocity of the current and the distances. The diluted concentrations of tritium at Port Elgin, which were only approximations at best, were higher than the measured values by up to a factor of five. A more accurate calculation of tritium concentration in Lake Huron would involve measuring several instantaneous parameters. (Wood-PTT)

UO2(2+)-HUMATE INTERACTIONS IN SOFT, ACID, HUMATE-RICH WATERS, Michigan State Univ., East Lansing. Dept. of Fish-eries and Wildlife. J. P. Giesy, R. A. Geiger, N. R. Kevern, and J. J. Alberts.

Journal of Environmental Radioactivity, Vol. 4, No. 1, p 39-64, 1986. 5 fig, 3 tab, 78 ref. US Dept. of Energy Contract DE-AC09-76SR00819.

Descriptors: *Fate of pollutants, *Chemical reactions, *Sample preparation, *Uranium, *Analytical techniques, *Plumic acids, *Binding capacity, *Path of pollutants, Stability constants, Oxidation, Laser fluorometry, Gaussian-Scatchard model, Model studies.

Model studies.

Few analytical techniques are sensitive enough to detect environmental concentrations of uranium in waters where humic acids are present. A technique for measuring humic-complexed and uncomplexed uranium at these concentrations was devised. Three techniques were combined to determine the binding capacity and conditional stability constant of uranium with Aldrich humic acid. Free UO2(2+) was separated from bound by chelating resin; the C-C bonds were destroyed by photo-oxidation and UO2(2+) was quantified by laser fluorometry. The binding capacity (BC) of 3.5 mg. C/liter Aldrich humic acid solution was estimated to be 0.00000114 M UO2(2+) with an asymptotic standard error of 5.0 times 10 to the minus 8th power M UO2(2+). UO2(2+) was bound to humic acid by a continuum of sites with different strengths. The frequency distribution of these sites was log-normal. A Gaussian-Scatchard model was used to estimate the overall conditional stability

Group 5B—Sources Of Pollution

constant for uranium concentrations of 5.25 times 10 to the minus 8th M to 2.1 times 10 to the minus 7th M in the presence of 3.5 mg/liter humate. The estimates of the mean and standard deviation for estimates of the mean and standard deviation for the log of the stability constants were 6.5 and 0.8, respectively. When these mean and standard devi-ations were used to determine the molo-average number of binding sites at three points on the Gaussian distribution, the estimators of log-stability constants were found to be: K sub 1 = 5.2, K sub 2 = 6.5 and K sub 3 = 7.7 with mole fractions of the total number of binding sites associated with each = 6.5 and K sub 3 = 7.7 with mole fractions of the total number of binding sites associated with each region of 0.21, 0.55 and 0.21 respectively. The thermodynamic, geochemical simulation model GEOCHEM and the three-component Gaussian-Scatchard estimates allowed accurate prediction of the relative proportion of UO2(2+) bound to humates for a soft water pond across the entire range of metal-ligand ratios studied. Approximately 22% of the UO2(2+) was predicted to be associated with dissolved organic carbon. (Author's abstract) W87-04580

GROUT AND SLURRY WALLS FOR HAZ-WASTE CONTAINMENT: THE DOWN SIDE, California Univ., Berkeley. Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 5G.
W87-04582

MODELING OF SOLUTE TRANSPORT IN AGGREGATED/FRACTURED MEDIA INCLUDING DIFFUSION INTO THE BULK MATRIX, Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.

A. Rasmuson.

Geoderma GEDMAB, Vol. 38, No. 1-4 p 41-60, September 1986. 16 fig, 2 tab, 17 ref.

Descriptors: "Path of pollutants, "Breakthrough curves, "Diffusion, "Sorption, "Mathematical models, "Mass transfer resistance, "Solute transport, Aggregates, "Model studies, Mathematical equations, Mass transfer, Soils, Ion transport.

The influence of mass-transfer resistance on solute transport and uptake in soils was stressed. The resistance is usually divided into three distinct stages: (1) diffusion of the component from the flowing water to the solid interface; (2) diffusion through the porous network of the aggregates (internal diffusion); and (3) the sorption process itself, when the component is bound to some sorption site in the micropores. The impact of internal diffusion (second mass transfer resistance) on ion-transport in soils was discussed in detail. This transport in soils was discussed in detail. This effect could be very important since large internal surfaces become available for sorption. Mathematical models were formulated and solved analyticalcal indoes were formulated and survey and the light of th the bulk soil matrix. The effects of various dimen-sionless parameters, taking into account transport distance, water velocity, flow porosity, film diffu-sion, diffusivity, sorption constant, reaction rate, longitudinal dispersion coefficient and aggregate radius were explored. The influences of aggregate shape and a particle size distribution were treated.

It was shown that if the area-to-volume ratio of siabs, cylinders and spheres were the same, identical breakthrough curves would be produced for cal breakthrough curves would be produced for short and long contact times. In the intermediate range the first breakthrough times were in the order of spheres < cylinders < slabs. Generally, compared to uniform aggregates, the effect of size distribution was to delay the breakthrough. This was most pronounced for particle size distributions which were skewed toward smaller particles. (Au-thor's abstract). thor's abstract) V87-04585

MULTISPECIES CATION LEACHING DURING CONTINUOUS DISPLACEMENT OF ELECTROLYTE SOLUTIONS THROUGH SOIL COLUMNS, Florida Univ. Columns. LEACHING THROUGH

Univ., Gainesville. Dept. of Soil Scien nsell, S. A. Bloom, H. M. Selim, and R.

Geoderma GEDMAB, Vol. 38, No. 1-4, p 61-75, September 1986. 6 fig, 1 tab, 19 ref.

Descriptors: *Path of pollutants, *Infiltration, *Soil solution, *Ion transport, *Model studies, *Mathematical models, *Leaching, *Cations, *Soil columns, *Electrolytes, Ions, Aggregates, Equacolumns, *Electrolytes, Ions, Aggregates, Electrolytes, Ions, Aggregates, *Electrolytes, Ions, Aggregates, *Electrolytes, Ions, Aggregates, *Electrolytes, Ions, Aggregates, *Electrolytes, Ions, Ions,

A model based upon concepts of multispecies ion chromatography and mobile-immobile water was developed to simulate the leaching of major soil cations during steady, continuous infiltration of electrolyte solutions into soil columns. This model assumed that a fraction of exchange sites was readily accessible to the mobile solution located in large intra-aggregate pores and that the remaining slowly accessible exchange sites were located in the immobile solution inside smaller pores within the aggregates. Ion exchange was assumed to the immobile solution inside smaller pores within the aggregates. Ion exchange was assumed to occur instantaneously for all of the partitioned exchange sites. Diffusive transfer of ions between the mobile and immobile solution phases resulted in a time lag for cation leaching from the two compartments of exchange sites, as well as early breakthrough curves for ion concentration in effluent flowing from the soil column. The numerical model was verified by comparing calculated breakthrough curves for 2-ion transport with those obtained with an analytical model and by simulating Mg(2+) to Ca(2+) exchange during steady flow of solutions through columns of three soils. Sensitivity analysis for mobile-immobile water parameters showed the model to describe cation transport through aggregated porous media. (Author's abstract) W87-04586

MODEL OF ION TRANSPORT THROUGH A FORESTED CATCHMENT AT LANGE BRAMKE, WEST GERMANY, Goettingen Univ. (Germany, F.R.). Abt. Boden-kunde und Waldernahrung.

M. Hauhs. Geoderma GEDMAB, Vol. 38, No. 1-4, p 97-113, September 1986. 14 fig, 2 tab, 16 ref.

Descriptors: "Path of pollutants, "Soil solution, "Acid rain, "Ion transport, "Catchment areas, "Forests, "Mathematical models, "Model studies, "Seepage, Lange Bramke, Spruce trees, Infiltration rate, Runoff, Transpiration, Pressure head, Watersheds Weight Long. sheds, Weirs, Ions

The ion transport through the Lange Bramke catchment is controlled by the trajectories of water flow through vertically stratified layers of soil. The size of the investigated catchment was 76 ha. The catchment was covered by a 35-year old Norway spruce stand (Picea abies Karst.). Water trajectories through the aloning soils were provid-Norway spruce stand (Picea ables Karst.). Water trajectories through the aloping soils were provided by a physical model of transient saturated/unsaturated water flow. This finite element model calculated from given daily infiltration and potential transpiration rates the pressure head distribution in the cross-section of the watershed and the tion in the cross-section of the watershed and the daily runoff. A model run from 1978 until 1981 agreed with measured daily sums of runoff at the weir and soil matric potential from various locations along the cross-section. The model results indicated that seepage under the spruce stand was characterized by a vertical direction within the first 80 cm of soil. Thus an ion budget for the subsoil could be calculated from monthly sums of seepage rates and means of soil solution chemistry from 80 cm depth. The chemical gradients between headwater, groundwater and runoff at Lange Bramke confirmed the trajectories derived from the hydrological model and the ion budget for the subsoil. (Author's abstract)

TRANSIENT MASS-TRANSPORT IN THE PRESENCE OF NON-LINEAR PHYSICO-CHEMICAL INTERACTION LAWS: PROGRESSIVE MODELLING AND APPROPRIATE EXPERIMENTAL PROCEDURES, Centre National de la Recherche Scientifique, Nancy (France). Lab. des Sciences du Genie Chemiches

mique. M. Sardin, R. Krebs, and D. Schweich.

Geoderma GEDMAB, Vol. 38, No. 1-4, p 115-130, September 1986. 7 fig, 2 tab, 26 ref.

Descriptors: "Path of pollutants, "Mass transfer, "Physicochemical properties, "Surfactants, "Soil columns, "Model studies, "Mathematical models, "Cation exchange, Equilibrium laws, Anionic surfaction exchange, Equilibrium laws, Anionic surfaction exchange, Equilibrium laws, Anionic surfaction exchange, Equilibrium laws, Anionic surfactions and the surface of the

A method for experimental investigations and theoretical modeling of the transient mass-transport of an anionic surfactant in a soil column was presented. The porous medium consisted of a sandstone containing slight amounts of clays and limestone. Emphasis was laid on the Na(+)/Ca(2+) cation exchange process, the solubilization of calcium carbonate, the precipitation of the surfactant with calcium ions and the transient coupling between bonate, the precipitation of the surfactant with calcium ions, and the transient coupling between these phenomena. A progressive modeling of the propagating concentration waves suggested the successive experiments which allowed the independent identification of physico-chemical parameters: pore volume and hydrodynamic dispersion, exchange capacity and selectivity factor, solubility of the limestone and of the calcic surfactant. The experiments consisted of suitably chosen step composition changes at the inlet of the column and of classical batch experiments. The asymmetrical elution curves, the multiple concentration fronts and the plateau-zones were shown to be exclusively tion curves, the multiple concentration fronts and the plateau-zones were shown to be exclusively due to the non-linear equilibrium laws. No kinetic process was involved. The predictive behavior of the model was illustrated by more complex experiments than those used to measure the physicochemical parameters. The model could also be applied to other systems with different sedimentary soils or different ionic solutes such as LiCl or NaHCO3 though it is necessary to apply the model with care not to ask more than it was designed to provide and with the given limitations in mind. (Wood-PTT) W87-04589

MIGRATION OF SOLUTES IN A CULTIVAT-ED SOIL: EFFECT OF PLOUGHING, Gesellschaft fuer Strahlen- und Unweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). For primary bibliographic entry see Field 2G. W87-04590

MODELS FOR SIMULATING SALT MOVE-MENT IN AGGREGATED FIELD SOILS, Agricultural Research Service, Riverside, CA. Sa-limity Lab. For primary bibliographic entry see Field 2G. W87-04591

APPLICATION OF SIMPLE LEACHING MODELS IN HETEROGENEOUS SOILS, Rothamsted Experimental Station, Harpenden (England). nary bibliographic entry see Field 2G. For primar W87-04592

EVIDENCES FOR THE EXISTENCE OF A RE-TENTION PHENOMENON DURING THE MI-GRATION OF A MERCURIAL SOLUTION THROUGH A SATURATED POROUS Strasbourg-1 Univ. (France). Inst. de Mechanique des Fluides.

P. Behra.

Geoderma GEDMAB, Vol. 38, No 1-4, p 209-222, September 1986. 6 fig, 2 tab, 26 ref.

Descriptors: *Path of pollutants, *Breakthrough, *Retention, *Mercury, *Saturated soils, *Porous media, *Aquifers, *Model studies, Mercury contamination, Aquifers, Model studies, Heavy metals, Hydroxides, Oxides.

The possibilities for mercury to migrate through a saturated porous medium were studied in order to estimate the risks of a mercurial contamination of an aquifer from a poliuted area. For this the mechanisms that control the spreading of a solution of mercury II salt through a porous matrix, with experimental, monodimensional models of the column type were investigated. The porous matrix

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used was a quartz sand. Different factors (processing of the porous matrix before mercury injection, NaCl concentration in the percolating solution) are shown to influence the breakthrough of mercury and its release from a contaminated porous medium. NaClO is able to release important quantities of mercury associated with iron, aluminum and manganese. The results suggest that mercury could be linked to the porous matrix either to clay minerals, or especially to iron, manganese or aluminum oxides and hydroxides. The influence of NaCl concentration; that ligand Cl(-) and mercury may constitute strong complexes, and that this could be the origin of a decrease in possibilities of retention were also observed. (Author's abstract)

STUDY OF TRACER MOVEMENT THROUGH UNSATURATED SAND, Vrije Univ., Brussels (Belgium). Lab. of Hydrolo-

Vrije Univ., Brussels (Belgium). Lab. of Hydrology. For primary bibliographic entry see Field 2G. W87-04594

CHEMICAL TRANSPORT UNDER NO-TILL FIELD CONDITIONS,

Science and Education Administration, Beltsville, MD.
T. J. Gish, W. Zhuang, C. S. Helling, and P. C.

Kearney. Geoderma GEDMAB, Vol. 38, No. 1-4, p 251-259, September 1986. 4 fig, 15 ref.

Descriptors: *Path of pollutants, *Tillage patterns, *Tillage efffects, *Chemical transport, *Untilled fields, *Pesticides, *Mathematical equations, *Mathematical studies, Atrazine, Glyphosphate, Alachlor, Cyanazine, Pesticide drift, Convection-dispersion equation, Adsorption, Degradation, Soil cores.

Inadequacies with present theoretical models which do not take into account the effect of soil structure, soil pore size distribution, and chemical diffusion coefficients were revealed in the study conducted on a Coderus silt loam located in Belts-ville, Maryland. Atrazine (2.8 kg/ha) in combination with glyphosphate and alachlor or cyanazine was sprayed on a field, which was planted with maize Zea mays L.). Seven hours after application, 45 surface samples of 144 sq cm each were removed and analyzed to determine the uniformity of the atrazine application. Five days later potassium bromide (113 kg/ha) was sprayed on the surface and 30 surface samples of 144 sq cm each were extracted and analyzed for volumetric water content and bromide concentration. Throughout the growing season five sets of cores were extracted to monitor atrazine movement under practical no-till management. Each set of soil cores subsequent to atrazine application contained 45 and 34 cores for bromide and atrazine, respectively. Each core was individually analyzed at 0.05 m intervals to a depth of approximately 0.45 m. Concentration data were subjected to a model that assumed pesticide movement obeys the convection-dispersion data were subjected to a model that assumed pesticide movement obeys the convection-dispersion equation including adsorption and degradation, with water velocity considered a stochastic variable. Analysis of the bromide data indicates that movement was in response to convective transport. However, the dispersion coefficient for bromide was greater than for atrazine by an order of magnitude. Predicting adsorption by calculating the retardation factor from field data greatly underestimated atrazine transport. (Wood-PTT)

MULTICOMPONENT TRANSPORT MODEL, Goettingen Univ. (Germany, F.R.). Abt. Bodenkunde und Waldernahrung. R. Forster.

Geoderma GEDMAB, Vol. 38, No. 1-4, p 261-278, September 1986. 8 fig, 2 tab, 10 ref.

Descriptors: "Path of pollutants, "Mathematical models, "Transport models, "Model studies, "Cation exchange, "Soil matrix, "Mathematical equations, Cations, Ion exchange, Equations, Ion pairing, Leaching, Convection-diffusion equation, Breakthrough curves.

Ion pairing, multi-species cation-exchange, leaching, and precipitation of salt are considered in a multicomponent transport model. The transport model is based on the convection-diffusion differential equation for steady state water flux with mobile/immobile water fraction and storage terms. The amounts of ions stored in the soil matrix are computed by a chemical equilibrium model. The chemical model considers the basic ions Al(3+), Ca(2+), Me(2+), M(1+), OH(1-), M(+) (= Na(+), K(+), Ca(2+), Mg(2+), Mn(2+)), A(-) (= Cl(-), NO3(-)) with their complexes in soil solution, and the exchangeable cations Al to the ex power, M to the ex power, H to the ex power, AlOHSO4(s) (salt) in the soil matrix. The resulting mixed system of partial differential and algebraic equations is solved by block-iterating the solution of the convection-diffusion equations and the solution of the convection-diffusion equations and the solution of the convection-diffusion equations and the solution of the program is used to model two breakthrough curves of KCl pulse experiments at a steady-state water flow of q = 0.1 cm/d, and q = 0.3 cm/d, respectively. The parameters of the convection-diffusion equations and pK sub AlOHSO4 are found by fitting. The AlOHSO4(s) plays a major role during the simulations. It precipitates during the KCl-pulse with released exchangeable aluminum and is dissolved again during a following regeneration phase of the cation exchange complex, thus serving as an intermediate storage for sulfate. (Author's abstract) W87-04597

EXPECTED SPECIATION OF DISSOLVED TRACE METALS IN GRAVITATIONAL WATER OF ACID SOIL PROFILES,

Ecole Polytechnique Federale de Lausanne (Switzerland). Inst. de Genie Rural.
A. C. M. Bourg, and J. C. Vedy.
Geoderma GEDMAB, Vol. 38, No. 1-4, p 279-292,
September 1986. 4 fig, 6 tab, 22 ref.

Descriptors: *Path of pollutants, *ADSORP2, *Speciation, *Trace metals, *Gravitational water, *Acidic soils, Brown soils, Humo-ferrugineous podzol, Equilibrium, Binding constants, Computer programs, Computers, Organic matter, Metals.

programs, Computers, Organic matter, Metals.

Typical compositions of major and minor components of gravitational water in the various horizons of two acid soils (an acid brown earth and a humoferrugineous podzol), available from other studies, are used to calculate the expected dissolved speciation of selected trace metals, assuming rapid equilibrium. The weakest reported binding constants between trace metals and dissolved organic matter in soils were used in the speciation calculations using the computer program ADSORP2. In spite of the weak constants used, organic complexes are significant species of trace metals in both soil types. They are always much more abundant than morganic complexes and in some cases (Cu and Pb in podzol A sub 1 horizon) they are even present in amounts similar to the free metal. The fate of the trace metals associated with the dissolved organic matter should follow the dynamics and evolution of their organic vectors. The free metal fraction whose size depends on the organic complexation constants, is available for either biological uptake (including upward recycling, a significant phenomenon in acid brown soils) or for further downward migration. (Author's abstract)

SORPTION KINETICS AND TRANSPORT OF PHOSPHATE IN SANDY SOIL,

Agricultural Univ., Wageningen (Netherlands).
Dept. of Soil Science and Geology.
S. E. A. T. M. Van der Zee, and W. H. Van
Riemsdiik.

Geoderma GEDMAB, Vol. 38, No. 1-4, p 293-309, September 1986. 9 fig, 3 tab, 26 ref.

Descriptors: "Path of pollutants, "Sorption, "Kinetics, "Sorption kinetics, "Phosphate transport, "Sand, "Phosphates, "Mathematical equations, "Model studies, Soil types, Adsorption, Langmuir kinetics, Precipitation, Breakthrough curves, Leaching, Isotherms.

The reaction of ortho-phosphate (P) with sandy soil is described by two processes: a fast and reversible adsorption according to Langmuir kinetics, combined with a non-equilibrium, irreversible, precipitation-like process. The precipitation reaction involves the bulk of oxides and has diffusion of P through a metal phosphate coating, that surrounds the oxide, as the rate limiting step. Model parameters are assessed by performing sorption and desorption experiments. With the parameter values obtained, the transport of P in packed columns is simulated. Good agreement between measured and calculated breakthrough curves is found for the transport of high feed concentration of P and for the leaching of a column presaturated with P. Transport experiments appear to produce additional information that is necessary in the assessment of model parameters. (Author's abstract) W87-04599

ANALYSIS FOR TRACE AMOUNTS OF GEOS-MIN IN WATER AND FISH, Agricultural Research Service, New Orleans, L.A. Southern Regional Research Center. For primary bibliographic entry see Field 5A. W87-04602

MODELLING THE BEHAVIOUR OF ORGAN-IC CHEMICALS IN SOIL AND GROUND WATER, Institute for Pesticide Research, Wageningen

(Netherlands).
M. Leistra.
Pesticide Science PSSCBG, Vol.

Pesticide Science PSSCBG, Vol. 17, No. 3, p 256-264, June 1986. 8 fig, 18 ref.

Descriptors: "Path of pollutants, "Fate of pollutants, "Organic compounds, "Reviews, "Model testing, "Mathematical models, "Computer programs, "Model studies, "Pesticides, "Soil properties, "Groundwater, Transformation, Soil structure, Root zone, Field tests, Simulation, Adsorption.

The development, testing and application of computer models for the behavior of organic chemicals, especially pesticides, in soil and ground water was reviewed. Detailed data are needed on the structure and properties of the soil and ground-water systems, and on the flow of water through these systems. Adsorption and transformation of organic chemicals can be studied in the laboratory and the results introduced into the models. The mathematical techniques most frequently used for the solution of the differential equations are briefly discussed. Some models for the behavior of pesticides in the root zone have been tested against results of field trials and some interesting deviations between computations and measurements emerged. Techniques for the simulation of the behavior of organic chemicals in the ground-water zone are also available. However input data for the models are often lacking, as are also results of field studies for testing the models. (Author's abstract) W87-04613

HYDROLYTIC STABILITY OF CHEMICALS -A COMPARISON OF EPA AND OECD PROTO-COLS AND SUGGESTIONS FOR A COM-BINED UNIVERSAL METHOD, Shell Research Ltd., Sittingbourne (England). Sittingbourne Research Centre. For primary bibliographic entry see Field 5A. W87-04614

EVALUATION OF MODELS USED TO ASSESS THE FATE OF CHEMICALS IN AQUATIC

Shell Research Ltd., Sittingbourne (England).
N. O. Crossland, D. Bennett, C. J. M. Wolff, and
R. P. J. Swannell.

Pesticide Science PSSCBG, Vol. 17, No. 3, p 297-304, June 1986. 2 fig, 6 tab, 15 ref.

Descriptors: *Performance evaluation, *Model studies, *Fate of pollutants, *Aquatic environment, *Water analysis, *Mathematical models, Sediments, Vegetation, Transport, Biodegradation, Bacteria, Evaporation, Sinks, Organic compounds, Prediction, Ponds, Mixing.

Group 5B-Sources Of Pollution

In aquatic toxicology the principle of assessing environmental hazards of toxic chemicals is well established. Such assessments depend on comparing threshold toxicity concentrations with expect-denvironmental concentrations with expect-manual programments of the environmental hazard to aquatic organisms. Estimates of threshold toxicity concentrations are usually obtained from the results of chronic toxicity tests using fish and aquatic invertebrates. Five reference chemicals, 2,5,4-crichlorobiphenyl (3-CB), chloroform, parathionmethyl (MEP), pentachlorophenol (PCP) and 3,4-dichloroaniline (DCA), were applied to experimental outdoor ponds by sub-surface injection. Samples of water, sediment and vegetation were removed and analyzed for residues at various intervals after treatment. The fate of these chemicals in the ponds was predicted through the use of process analyses and mathematical models. The predicted rates of loss were compared with experimental observations. Data obtained for 3-CB were fitted to a three-compartment model and this was used to calculate the rates of transport between water and acdiment, and between water and vegetation. These processes are primarily dependent on turbulent mixing. In experiments with MEP it was shown that biodegradation was primarily associated with bacterial populations in the sediment rather than with those suspended in the water. The rate of biodegradation in sediment was relatively fast and there was no detectable lag phase. The sediment could therefore be considered a sink for MEP and the overall rate of loss of the latter was dependent on its rate of transport to the sediment. In an experiment with chloroform there was resonably good agreement between predicted and observed rates of evaporation. However, observed rates were always greater than predicted rates, suggesting a systematic bias that may warrant further investigation. In experiments with PCP and DCA there was good agreement between predicted and observed rates of phototransformation. (Al-exander-PTT)

PREDICTION OF BIODEGRADABILITY BY THE USE OF QUANTITATIVE STRUCTURE-ACTIVITY RELATIONSHIPS: CORRELATION OF BIOLOGICAL OXYGEN DEMAND WITH ATOMIC CHARGE DIFFERENCE, Liverpool Polytechnic (England). School of Pharaccure.

J. C. Dearden, and R. M. Nicholson. Pesticide Science PSSCBG, Vol. 17, No. 3, p 305-310, June 1986. 1 fig, 21 ref.

Descriptors: *Biodegradation, *Molecular structure, *Bioaccumulation, *Toxicity, *Fate of pollutants, *Water pollution effects, *Biological oxygen demand, QSAR, Quantitative structure-activity relationships, Atomic charge difference, Prediction, Correlation analysis.

Correlation analysis.

Increasing concern about the adverse effects of chemical pollutants in the environment, and the increasing numbers of chemicals being released into the environment, make it imperative that ways be sought to predict such effects. One such way is by the use of quantitative structure-activity relationships (QSARs) which correlate physicochemical and/or structural parameters with a relevant biological property. Environmentally relevant biological property. Environmentally relevant properties are bioaccumulation, toxicity to an organism, and biodegradability, and all of these are now the subject of QSAR studies. The use of quantitative structure-activity relationships for the prediction of bioaccumulation, toxicity and biodegradability is briefly surveyed. A new parameter-the difference of the modulus of atomic charge across a selected bond in a molecule-is shown to correlate extremely well with 5-day biological oxygen demand for several series of compounds; furthermore, the equations for the several series are then combined to give a single, all-embracing correlation for the quantitative prediction of biodegradability. (Alexander-PTT)

APPLICATION OF REVERSE-PHASE H.P.L.C. FOR THE DETERMINATION OF PARTITION COEFFICIENTS,

Shell Internationale Research Maatschappij N.V., The Hague (Netherlands). For primary bibliographic entry see Field 5A. W87-04618

POLYCYCLIC AROMATIC HYDROCARBONS IN SOIL AT GROUNDWATER LEVEL NEAR AN EARTHEN PIT FOR PRODUCED WATER IN THE DUNCAN OIL FIELD, New Mexico State Univ., Las Cruces. Dept. of

Chemistry
B. Davani, K. Lindley, and G. A. Eiceman.
International Journal of Environmental Analytical
Chemistry IJEAA9, Vol. 25, No. 4, p 299-311,
1986. 4 fig, 1 tab, 12 ref.

Descriptors: *Path of pollutants, *Fate of Pollutants, *Water analysis, *Polycyclic aromatic hydrocarbons, *Produced water, *Groundwater, *Industrial wastewater, Aromatic compounds, Hydrocarbons, Soil sampling, Trace levels, San Yuan River, Dispersion, Mobility, Partition coefficients, Oil wells.

In production of oil and natural gas, large amounts of wastewater called produced water are generated at the well head. Hydrocarbons, polycyclic aromatic hydrocarbons (PAH), and alkylated PAH with two to four rings were found in soil at groundwater level down-gradient from an earthen waste disposal pit for produced water, in the Duncan Oil Field of NW New Mexico. Depth to groundwater was only 1 to 1.5 m in this flood plain of the San Yuan River. Complex mixtures of hydrocarbons with carbons numbers from 12 to 30 were detected in solvent extracts of soil samples collected 25 m and 50 m down-gradient from the waste pit. The concentration of total extracted organic mass was as large as 500 ppm at 25 m, but a reduction in concentration of 90 to 100% was seen for samples at 50 m on the same axes. No similar contamination was found in soil samples blocated on axes drawn up-gradient from the waste pit. Concentrations for total PAH in soil at 25 m distance from the waste pit were as large as 4900 ppb and 37 ppb at 50 m on the same axis. Detectable but trace amounts of PAH in samples up-gradient from the pit may be evidence for a secondary dispersion mechanism such as flooding of the region. While groundwater contamination with organic compounds from an earthen waste disposal pit has been demonstrated here, mobility, partition, and fate of PAH in complex mixtures in a soil/groundwater system remain undetermined. (Alexander-PTT)

LONG-CHAIN ALKYLBENZENES: THEIR AN-ALYTICAL CHEMISTRY, ENVIRONMENTAL OCCURRENCE AND FATE,

Massachusetts Univ. at Boston. Environmental Science Program.

R. P. Eganhouse. International Journal of Environmental Analytical Chemistry IJEAA9, Vol. 26, No. 3/4, p 241-263, 1986. 9 fig, 2 tab, 22 ref. DOE Contract EY-76-03-034

Descriptors: *Alkylbenzene sulfonates, *Anionic surfactants, *Detergents, *Fate of pollutants, *Path of pollutants, *Analytical chemistry, *Pollutant identification, *Water analysis, Municipal wastewater, Coastal waters, Sediments, Outfall sewers, California, Biodegradation, Distribution.

Since ca. 1950 long-chain alkylbenzenes have been produced industrially for the synthesis of alkylbenzenesulfonates, the anionic surfactants most commonly used in commercial detergents. Prior to 1965 the alkylbenzenes were generated by Friedel-Crafts alkylation of benzene with tetrapropylene. This reaction produces a complex assemblage of phenylalkanes (TABs) having highly branched side chains. Due to their stability, the TABs proved to be environmentally troublesome and were ultimately replaced (during the mid-1960s) by the linear alkylbenzenes (LABs). The LABs consist of a mixture of secondary phenylalkanes with linear alkyl side chains ranging in length from Cl0 to Cl4. Because of their unique structures and composition, these compounds are easily identified and

measured in complex environmental samples. The linear alkylbenzenes are also found in municipal wastewaters where their presence is thought to result from the use of domestic and industrial detergents. Because they are synthetic and unlikely to occur in other significant inputs to coastal marine waters, long-chain alkbenzenes have obvious potential as waste-specific molecular tracers. The presence of long-chain alkylbenzenes in sediment trap particulates and marine sediments collected near a major waste outfall system in southern California indicates that these hydrocarbons can survive exposure to an oxygenated water column during sedimentation. Whereas changes in the somer composition of the LABs with depth in the sediments are suggestive of microbial alteration, the vertical distribution of the TABs and LABs can be used as a geochronological tool to reconstruct waste depositional histories. (Author's abstract)

LINEAR ALKYLBENZENE SULFONATES (LAS) IN SEWAGE SLUDGES, SOILS AND SEDIMENTS: ANALYTICAL DETERMINATION AND ENVIRONMENTAL SAFETY CONSIDERATIONS,

Procter and Gamble European Technical Center, Brussels (Belgium). For primary bibliographic entry see Field 5A. W87-04623

WATER QUALITY OF AGRICULTURAL COASTAL PLAIN WATERSHEDS, Delaware Univ., Newark. Dept. of Agricultural Engineering. W. F. Ritter.

W. F. Ritter. Agricultural Wastes AGWADL, Vol. 16, No. 3, p 201-216, 1986. 6 fig, 7 tab, 14 ref.

Descriptors: "Water quality, "Agricultural watersheds, "Coastal plains, "Water pollution sources, "Runoff, "Rainfall, "Nutrients, Base flow, Nitrogen, Phosphorus, Chemical oxygen demand, Soil types, Storms, Streamflow, Watersheds, Pollution load.

In the past decade, there has been great national concern about water quality and its effect on public health, as well as fish, shellfish and wildlife safety. Many water quality monitoring projects have been initiated since the passing of the Federal Water Pollution Control Act. Runoffs from six rural watersheds in the Coastal Plain were monitored over a period of five years. Nitrogen, phosphorus and COD loading rates were developed for all the watersheds and related to land use and soil type. The nitrogen, phosphorus and COD content of rainfall was also measured. Annual total nitrogen loading rates varied from 3.2 to 42.5 kg/ha and annual total phosphorus loading rates from 0.37 to 1.08 kg/ha. More than 50% of the nitrogen and phosphorus loads occurred in baseflow. Highest nitrogen loads occurred on watersheds with well drained soils. Higher phosphorus loading rates occurred during storm events on watersheds with poorly drained soils than with well drained soils. Nitrogen, phosphorus and COD contributed by rainfall was greater than the loading rates occurring in streamflow. (Alexander-PTT)

AGRONOMIC VALUE OF THE SEWAGE SLUDGE OF TENERIFE. COMPOSTING, Centro de Edafologia y Biologia Aplicada de Tenerife (Spain).
For primary bibliographic entry see Field 5E. W87-04626

ISOLATION OF AN ANAEROBIC BACTERIAL CONSORTIUM DEGRADING PHENOLIC COMPOUNDS - ASSAY IN SWINE WASTE, Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Bacteriologie.
For primary bibliographic entry see Field 5D. W87-04627

ANALYSIS OF POLYCYCLIC AROMATIC HY-DROCARBONS IN SEDIMENTS, SEWAGE

Sources Of Pollution-Group 5B

SLUDGES AND COMPOSTS FROM MUNICIPAL REFUSE BY HPLC,

Tuebingen Univ. (Germany, F.R.). Inst. fuer Or-ganische Chemie.

For primary bibliographic entry see Field 5A. W87.04632

DETERMINATION OF ULTRA TRACE AMOUNTS OF COBALT IN FISH BY GRAPH-ITE FURNACE ZEEMAN EFFECT ATOMIC ABSORPTION SPECTROMETRY,

Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.

For primary bibliographic entry see Field 5A. W87-04633

QUANTITY OF LEAD SHOT, NYLON FISH-ING LINE AND OTHER LITTER DISCARDED AT A COARSE FISHING LAKE,

University of Wales Inst. of Science and Technology, Newbridge-on-Wye. Llysdinam Field Center. I. J. Forbes.

Biological Conservation BICOBK, Vol. 38, No. 1, p 21-34, 1986. 5 fig, 2 tab, 13 ref.

Descriptors: "Water pollution sources, "Fishing gear, "Lakes, "Litter, "Sport fishing, "Fishing, "Recreation, Environmental effects, Lead shot, Nylon fishing line, Fisheries.

In order to assess the impact of angling on the environment an attempt was made to estimate the quantity of angler litter present around a popular coarse fishery. The lake bank was divided into nine site categories which had experienced different degrees of angler pressure. Lead shot, nylon line and general litter were collected from sampling points within these sites and used to estimate total quantities around the lake. In total 41000 here. points within these sites and used to estimate total quantities around the lake. In total 41000 + or -14000 lead abot, 57 + or -21 km (96000 + or -35000 pieces) of nylon line and 106 sq m (5552 pieces) of general litter were estimated to occur on the entire bank. The vast majority of lead shot, nylon line and general litter was present in close proximity to the fishing points and these areas contained the highest litter densities, with lead shot up to 137 pieces/sq m, nylon line up to 188 pieces/sq m (2900 sq cm/sq m. It was concluded that anglers discarded the majority of the lead shot and nylon pieces during tackle manipulations and that anglers were also the source of a substantial quantity of the general litter which creates a large visual impact on the lake environment. (Author's abstract) abstract) W87-04657

POLYCHLORINATED BIPHENYL RESIDUES IN SOME MARINE ORGANISMS FROM THE BAIE DES ANGLAIS BAIE-COMEAU, QUEBEC, SAINT-LAWRENCE ESTUARY), Department of Fisheries and Oceans, Quebec. Fisheries Research Branch.

C. Delval, S. Fournier, and Y. Vigneault.
Bulletin of Environmental Contamination and
Toxicology BECTA6, Vol. 37, No. 6, p 823-829,
December 1986. 2 fig. 3 tab, 14 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Polychlorinated biphenyls, *Bioaccumulation, *Mollusks, *Fish, *Estuaries, Accumulation, Pollutants, Baie des Anglais, Baie-Comeau, Quebec, Saint-Lawrence Estuary, Monitoring, Food habits, Habitats.

Determination of the extent of PCB bioaccumulation in two molluse species, Mytilus edulis L. and Buccinum undatum L.,and in two fish species, Clupea harengus hardengus and Anguilla rostrata, from the Baie des Anglais (Baie-Comeau, Quebec) was reported. It was concluded that of the species examined, the whelk was the best organism to monitor PCB pollution in view of its distribution, nutritional mode and habitat. PCB concentrations in marine organisms from the Baie des Anglais were not alarming, but they indicated a general habitat deterioration. (Wood-PTT)

MERCURY, CADMIUM, AND LEAD IN BRIT-ISH OTTERS, Essex Univ., Colchester (England). Dept. of Biol-

ogy.
C. F. Mason, N. I. Last, and S. M. Macdonald.
Bulletin of Environmental Contamination and
Toxicology BECTA6, Vol. 37, No. 6, p 844-849,
December 1986. 1 fig. 1 tab, 16 ref.

Descriptors: *Path of pollutants, *Water pollution effects, *Sublethal levels, *Mercury, *Cadmium, *Lead, *Heavy metals, *Otters, *Bioaccumulation, England, Accumulation, Fish, Pollutants, Food chains, Mortality, Toxicity.

Otters are at the top of the food chain and feed largely on fish so they are especially vulnerable to the effects of bioaccumulation of pollutants since their aquatic habitat is often contaminated by chemical wastes from agricultural, industrial and domestic sources. There is little published data on heavy metals in tissues of European otters, therefore the mercury, lead and cadmium levels in the tissues of British otters was reported. Analyses were performed by atomic absorption spectroscoussues of British otters was reported. Analyses were performed by atomic absorption spectroscopy. The results obtained suggested that metal contamination at present is not causing direct mortality of otters though some of the animals examined contained levels of mercury and lead which approached concentrations known to produce sublethal effects in other mammals. (Wood-PTT) W87-04665

ESTIMATES OF NITRATE FORMATION IN RAIN AND SNOW SYSTEMS, Ford Motor Co., Dearborn, MI. T. Y. Chang.

T. Y. Chang. Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 2, p 2805-2818, February 20, 1986. 3 fig, 3 tab, 46 ref, append.

Descriptors: *Mathematical models, *Water pollution sources, *Acid rain, *Nitrates, *Rain, *Snow, *Chemical reactions, Conservation equations, Hydrometeors, Cloud liquid water, Snowflakes, Equations, Scavenging.

Starting from gas-phase and heterogeneous chemi-cal reaction mechanisms of NO sub y species of Starting from gas-phase and heterogeneous chemical reaction mechanisms of NO sub y species of oxides of nitrogen and conservation equations for chemical species and hydrometeors (cloud drop-lets, raindrops, and snowflakes), approximate expressions for estimating nitrogen oxide concentrations and nitrate formation in storm systems have been derived. These expressions are intended for moderately polluted, regional areas and for the average situations of large rain or snow systems where there is widespread weakly ascending air motion. With input parameters which are representative of average summer rainstorms and winter snowstorms in the northeastern United States, HNO3 generated within the storm systems (by scavenging of NO3, N2O5, and HNO3) is shown to contribute up to 10-30 micro-M/L in the ground level precipitation water. In this estimate, contributions from the moderately polluted, lowest layer (1-2 km) alone have been included, and N2O5 and NO3 as well as HNO3 have been assumed to be irreversibly scavenged by hydrometeors to produce aqueous nitrate. (Author's abstract)

CHEMICAL AND MICROPHYSICAL STUDIES OF NONPRECIPITATING SUMMER CLOUD IN ONTARIO, CANADA,

nt Service, Downsview

Atmospheric Environment Service, Downsview (Ontario).

W. R. Leaitch, J. W. Strapp, H. A. Wiebe, K. G. Anlauf, and G. A. Isaac.

Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 11, p 11821-11831, October 20, 1986. 8 fig, 5 tab, 45 ref.

Descriptors: *Remote sensing, *Water pollution sources, *Water analysis, *Acid rain, *Clouds, *Cloud liquid water, *Chemical studies, *Microphysical studies, *Cloud water acidification, Canada, Acidification, Cumulus clouds, Stratocumulus clouds, Aerosols, Ontario.

During the fall of 1981 and the summer of 1982, airborne and ground-level field studies were con-

ducted in southern and central Ontario to investigate the processes leading to cloud water acidification. Aircraft measurements were made of aerosol particles, cloud droplets, and cloud liquid water content. Cloud water samples were collected in nonprecipitating cumulus and stratocumulus clouds and analyzed for water concentrations of SO4(2-), NO3(-), Cl(-), Na(+), NH4(+), Ca(2+), Mg(2+), and H(+). Aerosol composition was studied at a rural location on the ground. The ground-level aerosol composition was compared with the cloud water composition. Observations of the vertical variation of the aerosol particle size distribution were used to justify this procedure, but it was assumed that the relative fraction of submicron aerosol SO4(2-) did not vary between the ground and cloud base during individual flights. In this way the cloud water GO4(2-) was explained by the nucleation of water droplets on sulfate aerosol particles in at least nine of 11 cases studied. In several of the cases the concentration of NO3(-) measured in cloud water samples was much higher than could be accounted for by the measurement of below-cloud aerosol NO3(-) plus gaseous HNO3. Similarly, concentrations of Ca(2+) found in the cloud water far exceeded concentrations measured in the aerosol. (Author's abstract)

RATE OF PRECIPITATION SCAVENGING OF NITRATES ON CENTRAL LONG ISLAND, State Univ. of New York at Stony Brook. Dept. of Mechanical Engineering. K. R. Sperber, and S. Hameed. Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 11, p 11833-11839, October 20, 1986. 2 fig. 4 tab. 40 ref.

fig, 4 tab, 40 ref

Descriptors: "Fate of pollutants, "Weather data collections, "Acid rain, "Precipitation, "Nitrates, "Nitrate scavenging, "Rainfall, "Scavenging coefficients, "Mathematical equations, "Model studies, now, Long Island, Statistics, Deposition, Comparison studies, Stochastic process, Prediction.

parison studies, Stochastic process, Prediction.

By comparing deposition of nitrate in successive hours of precipitation samples taken over a six year period at Brookhaven National Laboratory, Long Island, NY, the scavenging coefficients in air for nitrate under a variety of meteorological and seasonal conditions were estimated. The square root transformation of the scavenging coefficients to the 1/2 power yields an approximately normal distribution; the mean value is 0.00011/s, in general agreement with previous experimental and theoretical estimates. An interesting property of the distribution of the scavenging coefficients is that the ratio of their mean value to the 1/2 power to the standard deviation varies little from 2.4 for various subsets of data; this property may limit the choice of stochastic models which describe the scavenging process. A trend analysis of the relationship between scavenging coefficients and rainfall rate does not increase for rainfall rates < or = 3.2 mm/h. The indicated increase at greater rainfall rates is qualitatively similar to model predictions, but is based upon a small number of data points. The mean scavenging coefficient for winter rain events is greater than for snow. (Author's abstract) W87-04678

TRANSPORT OF OZONE BETWEEN BOUNDARY LAYER AND CLOUD LAYER BY CUMU-

LUS CLOUDS,
National Oceanic and Atmospheric Administra-tion, Boulder, CO. Environmental Sciences Group. For primary bibliographic entry see Field 2B. W87-04679

CHEMISTRY OF OH IN REMOTE CLOUDS AND ITS ROLE IN THE PRODUCTION OF FORMIC ACID AND PEROXYMONOSUL-

HATVARd Univ., Cambridge, MA. Center for Earth and Planetary Physics. D. J. Jacob.

D. J. Jacob.
Journal of Geophysical Research D) JGRDE3,
Vol. 91, No. 9, p 9807-9826, August 20, 1986. 12
fig, 4 tab, 106 ref. NASA Grant NAGW-731; NSF

Group 5B-Sources Of Pollution

Grant ATM-83-17009.

Descriptors: *Water pollution sources, *Acid rain, *Clouds, *Hydroxy radicals, *Formic acid, *Peroxymonosulfate, *Chemical reactions, *Cloud liquid water, *Model studies, Chemical equations, Oxidation, Chemical mechanisms.

The chemistry of OH in a remote nonprecipitating tropical cloud is studied with a coupled gas-phase and aqueous-phase chemical model. The model takes into account the radial dependence of the and aqueous-pnase chemical model. The model takes into account the radial dependence of the concentrations of short-lived aqueous-phase species, in particular O3(aq) and OH(aq). The radical OH(aq) is produced rapidly by the aqueous-phase reactions O2(-) + O3 and H2O2 + hv and is removed primarily by oxidation of H2C(OH)2. H2O2, and HCOO(-). Gas-droplet transfer of OH must be modeled as a reversible process, that is, the droplets cannot be assumed to be diffusion-limited OH(g) sinks. A strong OH(aq) concentration gradient exists between the surface and the interior of the droplets. The concentration of OH(aq) is strongly dependent on pH but is only weakly dependent on the sticking coefficient, the droplet radius, or the liquid content of the cloud. Formic acid is rapidly produced by the aqueous-phase reaction H2C(OH)2 + OH, but HCOO(-) is in turn rapidly oxidized by OH(aq). The HCOOH concentration in cloud is shown to be strongly dependent on cloud water pH; clouds with pH greater than 5 are not efficient HCOOH sources. A novel mechanism is proposed for the oxidation of S(IV) by OH(aq). The main product is resolited to be are not emicient HCJOH sources. A novel mechanism is proposed for the oxidation of S(IV) by OH(aq). The main product is predicted to be HSOS(-) (peroxymonosulfate). Peroxymonosulfate appears to be stable in remote clouds and could contribute a large fraction of total cloud water sulfur. (Author's abstract)

ANALYSIS OF REMOTE MEASUREMENTS OF TROPOSPHERIC CARBON MONOXIDE CONCENTRATIONS MADE DURING THE 1979 SUMMER MONSOON EXPERIMENT 1979 SUM (MONEX),

Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences. For primary bibliographic entry see Field 2B. W87-04683

CHANGES IN PRECIPITATION CHEMISTRY

CHANGES IN PRECIPITATION CHEMISTRY AT DYE 3, GREENLAND, State Univ. of New York at Buffalo. Ice Core Lab. R. C. Finkel, C. C. Langway, and H. B. Clausen. Journal of Geophysical Research (D) JGRDE3, Vol. 91, No. 9, p 9849-9855, August 20, 1986. 4 fig, 1 tab, 17 ref. NSF Grant DDP-8117750.

Descriptors: "Path of pollutants, "Anthropogenic sources, "Chemical composition, "Chemical precipitation, "Ions, "Ice, Nitrates, Sulfates, Anthropogenic sources, Conductivity, Greenland, Seasonal variation, Deposition.

Measurements of the chemical composition (Cl(-), NO3(-), SO4(2-), and H(+)) of ice core samples from Dye 3, Greenland, show recent increases in the concentration of nitrate and sulfate which can be attributed to anthropogenic sources. These anthropogenic sources have changed not only the magnitude of impurity levels in Greenland snow but also the seasonal pattern of impurity concentration. The observed change in seasonal deposition patterns between preindustrial and industrial times is used to analyze the sources of both natural and anthropogenic impurities in Greenland. (Author's anthropogenic impurities in Greenland. (Author's

SPECIATION, PHOTOSENSITIVITY, AND REACTIONS OF TRANSITION METAL IONS IN ATMOSPHERIC DROPLETS,
Bell Communications Research, Inc., Holmdel, NJ. For primary bibliographic entry see Field 2B. W87-04686

SURROGATE-ASSISTED DETERMINATION OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN IN FISH BY ELECTRON CAPTURE CAPILLARY GAS CHROMATOGRAPHY,

Food and Drug Administration, Washington, DC. Contaminants Chemistry Div. For primary bibliographic entry see Field 5A. W87-04691

ATMOSPHERIC DEPOSITION IN FENNO-SCANDIA: CHARACTERISTICS AND TRENDS, Norsk Inst. for Luftforskning, Kjeller. A. Semb, and H. Dovland.

Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 5-16, September 1986. 6 fig, 2 tab, 15

Descriptors: *Water pollution sources, *Acid rain, *Water analysis, *Air pollution, *Precipitation, *Sulfur emissions, Europe, Scavenging, Transport, Fuel, Air quality data, Statistical analysis, Chemical analysis, Deposition.

An overview of the present situation with respect to long-range transport and deposition of S and N compounds in Northern Europe is presented. The discussion is based on known emission trends and compounds in Northern Europe is presented. The discussion is based on known emission trends and changes in fossil fuel consumption patterns, and a record of precipitation chemistry and air quality data for background sampling stations since the early 1970s. Chemical analyses of daily precipitation samples from background' stations in Europe are discussed together with measurements of airborne SO2 and sulfate aerosol, and trends in energy usage and SO2 emissions. Emission sources contributing to the major part of the concentrations of sulfate and nitrate in precipitation are mostly 500 to 1000 km from the receptor area. Although there are no general statistically significant trends in the precipitation chemistry data, minor changes point to an effect of reduced SO2 emissions in some areas. The daily data can be used to infer general conclusions with respect to preto infer general conclusions with respect to pre-cipitation scavenging efficiency. (Alexander-PTT) W87-04694

ACIDIC DEPOSITION AND ITS EFFECTS ON THE FORESTS OF NORDIC EUROPE, Sveriges Lantbruksuniversitet, Uppsala. Inst. foer Ekologi och Miljoevaard. For primary bibliographic entry see Field 5C. W87-04695

MEASURING DRY DEPOSITION: A RE-AS-SESSMENT OF THE STATE OF THE ART, National Oceanic and Atmospheric Administra-tion, Oak Ridge, TN. Air Resources Atmospheric Turbulence and Diffusion Lab. For primary bibliographic entry see Field 5A. W87-04699

POLLUTANT WET DEPOSITION MECHANISMS IN PRECIPITATION AND FOG WATER, eric Environment Service, Downsview

Attinospheric Edvironment Service, Downsview (Ontario). L. A. Barrie, and R. S. Schemenauer. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 91-104, September 1986. 5 fig, 33 ref.

Descriptors: *Water pollution sources, *Acid rain, *Path of pollutants, *Precipitation, *Wet deposition, Fog water, Scavenging, Cloud physics, Air pollution, North America, Weather systems.

Wet deposition of acid-related substances takes place by two processes: precipitation scavenging and fog water impaction/sedimentation on natural surfaces. The relative importance of each deposition pathway depends on the frequency of occurrence of precipitation or fog, the magnitude of the event and the efficiency of pollutant removal by each mechanism. The latter, in turn, is governed by the type of cloud or fog complex precipitation. each mechanism. The latter, in turn, is governed by the type of cloud or fog, complex precipitation formation mechanisms and cloud-surface interactions. These factors are examined in the light of current knowledge. Particular emphasis is placed on how cloud micro-physical as well as air and precipitation measurements, made aloft by aircraft and at the ground, have been used to further knowledge of wet deposition mechanisms. Future research is needed to quantify the importance of the fog-water deposition pathway in eastern North

America to better understand the interaction of gaseous pollutants with cloud and fog-water and to improve knowledge of pollutant scavenging processes in mesoscale and synoptic weather systems. (Author's abstract) W87-04700

ATMOSPHERIC MEASUREMENTS OF NI-AIMOSPHERIC MEASUREMENTS OF NITROGEN DIOXIDE WITH A SENSITIVE LU-MINOL INSTRUMENT, Unisearch Associates, Inc., Concord (Ontario). For primary bibliographic entry see Field 7B.

RAIN, SNOW AND LAKE WATER CHEMISTRY ON AND NEAR THE PRECAMBRIAN SHIELD OF WESTERN CANADA,
Saskatchewan Research Council, Saskatoon. For primary bibliographic entry see Field 2B. W87-04702

ACIDIC PRECIPITATION IN WESTERN NORTH AMERICA: TRENDS, SOURCES, AND ALTITUDE EFFECTS IN NEW MEXICO 1979-

New Mexico Inst. of Mining and Technology,

Socorro. C. J. Popp, D. K. Brandvold, A. Long, and L.

Watre, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 125-133, September 1986. 1 fig. 3 tab, 15 ref. New Mexico State Mining and Mineral Re-sources Research Inst. Project 9C-EF-10-9.

Descriptors: *Water pollution sources, *Altitude effects, *Acid rain, *Precipitation, Deposition, Sulfates, Sulfur emissions, Isotope studies, Scavenging, Air pollution, Smelters, New Mexico, North

America.

Determination of the presence of acidic precipitation in the Rocky Mountain and southwestern clearer regions of the western United States has only recently received attention in the acid rain literature. Because of the low population density, lack of industrialization and urbanization, and alkaline nature of much of the soil, it has generally been assumed that acidic precipitation, even if present, would probably not have deleterious effects. However, the volume-weighted pH values often average lass than 5 and, therefore, may be cause of concern, specifically at high altitudes. Volume-weighted pH values in central New Mexico have averaged 3.8 to 5.1 during the period 1979-1985. Samples collected at a high altitude site (3200m) have lower pH values than found for low altitude samples (1400m). Both dry deposition and event-averaged pH values have been higher than the volume-weighted averages due to neutralization by terrestrial material. During the period 1980-1984, changes in pH values and wet sulfate loading have correlated to SO2 emissions from regional non-ferrous smelters. Sulfur isotope analyses of sulfate extracted from regional arin samples yielded a delta 34S sub CD(%) of + .391 + or -11, indicating very little regional differentiation which, in turn, suggests that the regional atmospheric sulfate seavenged by precipitation is well-mixed and relatively homogeneous. (Alexander-PTT) PTT) W87-04703

PATTERNS OF ACID DEPOSITION TO A DANISH SPRUCE FOREST, Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology.

N. E. v Freiesleben, C. Ridder, and L. Rasmussen. Water, Air and Soil Pollution WAPLAC, Vol. 30, 100 (1975). No. 1/2, p 135-141, September 1986. 1 fig, 1 tab, 21

Descriptors: *Water pollution sources, *Acid rain, *Precipitation, *Throughfall, *Path of pollutants, *Canopy, *Forests, Water analysis, Anions, Cations, Acidity, Denmark, Spruce trees.

The chemical composition of precipitation is sub-stantially altered on passage through a tree canopy due to downwash of particles and gases deposited

Sources Of Pollution—Group 5B

on the plant surface as well as uptake and release of substances by the tree. Significant spatial variation in throughfall chemistry must be expected. Bulk precipitation and bulk throughfall was collected during the period September to November 1984 in a Danish spruce forest. Samples were analyzed for all major anions and cations as well as strong and total acidity. The acid load to the forest ecosystem was estimated adding the throughfall fluxes of protons (79 eq/ha/mo), ammonium (99 eq/ha/mo) and a calculated estimate of the protons buffered by exchange processes in the canopy (75 eg/ha/mo) and a calculated estimate of the protons buffered by exchange processes in the canopy (75 eq/ha/mo). This is still a minimum estimate but it exceeds the proton load determined by pH meas-urement in bulk throughfall and bulk precipitation by factors of 3 and 6, respectively. Throughfall fluxes of all major cations and anions except am-monium decreased with distance from the trunk. (Alexander-PTT)

CHEMICAL COMPOSITION OF PRECIPITA-TION AT LONG ISLAND, NY, Brookhaven National Lab., Upton, NY. Dept. of Energy and Environment. For primary W87-04705 nary bibliographic entry see Field 5A.

COMPARISON OF SUMMER AND WINTER MEASUREMENTS OF ATMOSPHERIC NITROGEN AND SULPHUR COMPOUNDS,

Atmospheric Environment Service, Downsview (Ontario). For primary bibliographic entry see Field 5A.

W87-04706

LICHEN SULPHUR AND LEAD LEVELS IN RELATION TO DEPOSITION PATTERNS IN EASTERN CANADA,

Atmospheric Environme (Ontario).

Condition.

E. M. Zakshek, K. J. Puckett, and K. E. Percy.

Water, Air and Soil Pollution WAPLAC, Vol. 30,

No. 1/2, p 161-169, September 1986. 8 fig, 17 ref.

Descriptors: "Water pollution sources, "Path of pollutants, "Acid rain, "Precipitation, "Lichens, "Deposition patterns, "Sulfates, "Lead, Canada, Spatial distribution, Regional analysis, Ontario, Newfoundland, Emissions.

spanial distribution, Regional analysis, Ontario, Newfoundland, Emissions.

The atmosphere is an important pathway for the dispersion of potentially toxic elements. Large spatial and temporal variations in element deposition occur making it difficult to define trends in deposition on a regional scale. Consequently, various plant types which accumulate these elements have been used to monitor these trends. Both lichens and mosses have been used extensively to monitor deposition because they are dependent to a large extent on wet and dry deposition to the plant surface for their mineral nutrients. The high retention capacity of these plants results in plant element concentrations in excess of their expected physiological needs. This high retention capacity together with their perennal nature has led to the extensive use of these plants as long term integrators of atmospheric elemental deposition. Marked differences exist between the S and Pb concentration in Cladina rangiferina collected from eastern Canada and the Northwest Territories, Canada. These differences reflected the differing emission/deposition rates in the two regions. The spatial distribution of S and Pb in the lichen from eastern Canada is described in detail. Mean S concentrations ranged from 329 to 959 microgram(ug)/g; Pb concentrations varied in the range 3 to 21 ug/g. A regional gradient in lichen S concentrations was evident with the highest concentrations being found in central and north-central Ontario and the lowest in Newfoundland. A regional gradient for Pb was apparent but was not as well defined as that for S. The regional distribution of S illustrated by the lichen agreed with another indirect measurement of S deposition. Lichen S concentrations Carlead with measured wet sulfate deposition. (Alexander-PTT)

DISTRIBUTION OF POLLUTANTS NEAR A FRONTAL SURFACE: A COMPARISON BETWEEN FIELD EXPERIMENT AND MODEL-

Atmospheric Environment Service, Downsview (Ontario). C. M. Banic, G. A. Isaac, H. R. Cho, and J. V.

Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 171-177, September 1986. 2 fig, 4 ref.

Descriptors: *Weather systems, *Acid rain, *Path of pollutants, *Water pollution sources, *Comparison studies, *Field tests, *Model studies, Air pollution, Atmospheric physics, Clouds, Mathematical models, Remote sensing, Air chemistry, Pollutant distribution, Canada.

distribution, Canada.

Frontal systems are responsible for much of the precipitation, often quite acidic, that falls on the acid sensitive areas of North America. The distribution of pollutants near the frontal surface is of interest since fronts form the boundary between different air masses, which often have very different pollutant concentrations. A number of frontal systems passed through the experimental area during the 1984 North Bay Acid Snow Study. Two different cold frontal systems were examined using aircraft instrumented for cloud and air chemistry, and cloud microphysics measurements. A distinct maximum in aerosol particle number concentration was detected near both frontal surfaces. In at least one case, a peak in NOx concentrations was observed simultaneously with the aerosol particle maximum. Using a model of frontogenesis, the aerosol particle layer can be explained in terms of air circulations associated with a front. The model also demonstrates how better flight plans might be designed for air chemistry studies using aircraft. (Alexander-PTT) /87-04708

MONTHLY MEAN SPATIAL VARIATIONS OF DRY DEPOSITION VELOCITIES OF OXIDES OF SULPHUR AND NITROGEN,

at of the Enviro nt. Ottawa (Ontar-

E. C. Voldner, and A. Sirois. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 179-186, September 1986. 2 fig, 18 ref.

Descriptors: *Water pollution sources, *Acid rain, *Path of pollutants, *Acid deposition, *Air pollution, *Model studies, *Regional analysis, Sulfur oxides, Nitrogen oxides, Oxides, Weather data collections, Spatial variation, Reviews, Deposition ve-

locity, Deposition.

Dry deposition processes play an important role in delivering acidic SOx and Nox to the surface. Modeled regional S and Noutgets in North America indicate that about half of the total deposition is dry deposition, there is advantage to be gained in more accurately representing dry deposition in "acid deposition" model calculations. A scheme, based on a resistance analogy, for estimating areal-average deposition velocities of gaseous and particulate oxides of S and N is used. From a literature review of observations, estimates of surface resistances for gases and near surface resistances for particles are obtained. Boundary layer theory and meteorological data are used to estimate aerodynamic resistances for gases and particulates as well as near surface resistance for gases. Coupled with information on land-use, monthly mean dry deposition velocity fields are obtained. The parameterization schemes and the required data bases are briefly reviewed. Spatial and temporal variation in dry deposition velocities of the oxides are discussed. (Author's abstract)

EFFECT OF A STRATUS CLOUD ON THE RE-DISTRIBUTION AND TRANSFORMATION OF POLLUTANTS,

Toronto Univ. (Ontario). Dept. of Physics. H.-R. Cho, J. V. Iribarne, T. A. Kavassalis, O. T. Melo, and Y. T. Tam. Water, Air and Soil Pollution WAPLAC, Vol. 30,

No. 1/2, p 195-203, September 1986. 3 fig, 3 tab, 3 ref. Canadian Electrical Assoc. Contract 403 G

Descriptors: *Path of pollutants, *Acid rain, *Fate of pollutants, *Stratus clouds, *Mathematical models, *Weather systems, *Precipitation, Free radicals, Scavenging, Temperature effects, Atmospheric physics, Model studies.

The role of clouds in the transport and transforma-tion of air pollutants is one of the main problems in acid rain research. A great deal of research, both experimental and theoretical, is being done to imacid rain research. A great deal of research, both experimental and theoretical, is being done to improve understanding of the role of clouds. A schematic bidimensional model was developed to describe an extended stratus formed by warm, moist air in a frontal system. Parcel trajectories are followed through the cloud, and the formation of precipitation is considered on the basis of simple assumptions. To the dynamic description, a chemical module was coupled, which includes the oxidation of SO2 in aqueous-phase (by H2O2, O3 and radicals extenged from interstitial air) and that of NO and NO2 in gaseous phase with subsequent dissolution of HNO2 and HNO3. The pH of precipitation is calculated. Sensitivity tests were run dissolution of HNO2 and HNO3. The pH of pre-cipitation is calculated. Sensitivity tests were run to study the influence of various dynamic, micro-physical and chemical parameters, such as cloud base temperature, cloud thickness, vertical veloci-ties, initiation temperature and distribution of pre-cipitation in the cloud, and the initial concentra-tions of different chemical species. (Alexander-DTT)

MODELING OF THROUGHFALL CHEMISTRY AND INDIRECT MEASUREMENT OF DRY DEPOSITION, Oklahoma State Univ., Stillwater. School of Chemical Engineering.
A. H. Johannes, Y. L. Chen, K. Dackson, and T. Suleski.

Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 211-216, September 1986. 8 fig, 6 ref.

Descriptors: *Mathematical models, *Throughfall, *Acid rain, *Path of pollutants, *Water pollution sources, *Precipitation, *Dry deposition, *Canopy, *Water analysis, *Pollutant identification, *Forests, Leaching, Watersheds, Leaves, Washoff, Prediction, Estimating.

Precipitation over a forested waterahed is altered by interaction with plant surfaces which act as a filter for airborne gases and particles. This results in a major transfer to the forest floor of materials captured, washed, and leached from the forest canopy. Sequential samples of wetfall and sequential samples of wetfall and sequential samples of or sequential analyzed for major anions and cations. A simple washoff, mixing model based on leaf area index was used to simulate throughfall hermistry and to decouple foliar exudation from dry deposition. Model results gave excellent predictions of the measured sequential throughfall using estimated values of dry deposition. The model can also be used to calculate dry deposition, if the sequential used to calculate dry deposition, if the sequential throughfall data and wetfall data are used as input variables. (Author's abstract)
W87-04713

RAINFALL ACIDITY IN NORTHERN BRIT-AIN - EXPLORING THE DATA, Institute of Terrestrial Ecology, Edinburgh (Scot-For primary bibliographic entry see Field 5A. W87-04716

ROLE OF ALKALINE MATERIALS IN PRE-CIPITATION CHEMISTRY: A BRIEF REVIEW OF THE ISSUES, Illinois State Water Survey Div., Champaign. D. F. Gatz, W. R. Barnard, and G. J. Stensland. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 245-251, September 1986. 2 tab, 12 ref. NOAA Contract NA\$2RACOO153, NSF Grant ATM 83-16643.

Descriptors: *Fate of pollutants, *Acid rain, *Pre-cipitation, *Alkaline materials, *Water pollution

Group 58-Sources Of Pollution

sources, *Reviews, Deposition, Emissions, Mathematical models, Model studies, Monitoring, Weathering, Air pollution.

A brief overview of the relatively unexplored role of alkaline materials in precipitation chemistry is provided. Alkaline materials can play fully as important a role as acidic materials in determining pH. Comparison of Ca/K and Ca/Mg ratios in precipitation and dry deposition with those in likely sources indicates that both unpaved roads and soils make important contributions. Elemental emissions fluxes have been derived from literature estimates of mass emissions fluxes and element abundances in the important sources, but are subject to large uncertainties owing to a lack of adequate data. It is quite clear, however, that convenional (smokestack) sources are minor compared to open sources such as those already identified. Interactions between alkaline aerosols and water in the atmosphere are discussed. Reactions involving open sources such as mose areasy architectures the temperature are discussed. Reactions and water in the atmosphere are discussed. Reactions involving supeneds solids that lead to removal of H-ions from solution include ion exchange and mineral weathering. A simplified model of acid buffering indicates that NH4, Ca, Mg, K, and Na buffer between 25 and 50% of the potential acids in U.S. precipitation everywhere east of the Mississippi River. Wet and dry deposition fluxes of alkaline materials are discussed. Wet deposition fluxes are currently being measured adequately by a nation-wide network of weekly samplers. There is no agreed-upon method for monitoring dry deposition, but available information suggests that dry deposition accounts for somewhat more than half of the Ca deposition. A list of research and data needs is also provided. (Author's abstract) W87-04717

SNOW CHEMISTRY IN THE FLIN FLON AREA OF MANITOBA, 1981-1984, Manitoba Dept. of Environmental Management, Winnipeg.
S. F. Phillips, D. L. Wotton, and D. B. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 253-261, September 1986. 3 fig, 2 tab, 8

Descriptors: *Snow chemistry, *Snowpack, *Snow, *Pollutant identification, *Path of pollutants, Deposition, Smelters, Emissions, Air pollution, Heavy metals, Monitoring, Winds, Dispersion, Flin Flon, Manitoba, Environmental impact.

Precipitation monitoring has been used extensively in both North America and Europe to monitor the 'acid rain' phenomenon. Precipitation monitoring was previously conducted in the area of Flin Flon, Manitoba, Canada in 1976 and 1977. Analyses of the naturally deposited snow pack was an effective method of monitoring the dispersion of air pollutants. The March snowpack was sampled at seven sites along two 40 km transects southeast and south southeast of the Hudson Bay Mining and Smelting Co. smelter in Flin Flon, Manitoba, Canada, from 1981 to 1984. The purpose was to determine depo-Co. melter in Flin Flon, Manitoba Canada, from 1981 to 1984. The purpose was to determine deposition patterns of smelter emissions to use in environmental impact assessment. Zinc deposition decreased with distance from the smelter according to an inverse curvilinear relationship, thus implicating the smelter as the source. Prevailing northwest winds resulted in higher deposition in the southeast than in the south southeast direction. Snowpack monitoring responded effectively to the reduction in emissions which occurred when a new electrostatic precipitator was installed. There is no evidence that sulfate-S in the snow originated from melter emissions even though there were up to amelter emissions even though there were up to 800 ton/day of SO2 emitted. The pH of the snow decreased with distance from the smelter and was positively correlated with heavy metals. pH was not correlated with affate deposition. Snow monitoring was an effective and sensitive tool for determining smowpack chemistry and air pollutant dispersion around the smelter at Flin Flon. (Alexander-PTT) W87-04718

SPATIAL AND TEMPORAL PATTERN OF SULFATE AND NITRATE WET DEPOSITION IN ONTARIO,

Ontario Ministry of the Environment, Toronto. A. J. S. Tang, W. H. Chan, D. H. S. Chung, and M. A. Lusis. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 263-273, September 1986. 6 fig, 5 ref.

Descriptors: "Wet deposition, "Water pollution sources, "Acid rain, "Spatial variation, "Temporal variation, "Sulfates, "Nitrates, "Precipitation, "Kriging, Seasonal variation, Rainfall, Deposition,

In response to the need to estimate long term wet deposition amount, as well as the pattern of air pollutants in Ontario, the Ontario Ministry of the Environment has set up a cumulative network in the fall of 1980. Before the end of 1981, samples were collected over a monthly period. Starting from January 1982, a 28-day sampling period was adopted. The 36 sampling sites have been distributed more densely in southern Ontario than in northern Ontario. The spatial patterns of the precipitation-weighted mean concentration and total deposition of sulfate and nitrate in Ontario were determined using the Modified Simple Kriging method. The 3-yr averaged apatial patterns of sulfate and nitrate concentrations were similar to the sulfate and nitrate - 3-yr averaged deposition patterns in nurate concentrations were similar to the suntate and nitrate 3-yr averaged deposition patterns in Ontario. The overall spatial variability of nitrate was slightly higher than sulfate. The seasonal variation of nitrate concentrations and deposition were less regular than sulfate. (Alexander-PTT) W87-04719

SPATIAL AND TEMPORAL VARIATION OF THE SULPHATE TO NITRATE RATIO IN PRECIPITATION IN EASTERN NORTH

heric Environment Service, Downsview

Atmospheric Environment Service, Downsview (Ontario).
P. W. Summers, and L. A. Barrie.
Water, Air and Soil Pollution WAPLAC, Vol. 30,
No. 1/2, p 275-283, September 1986. 4 fig. 2 tab, 11

Descriptors: *Spatial variation, *Temporal varia-tion, *Sulfates, *Nitrates, *Water pollution sources, *Acid rain, *Precipitation, *Mathematical models, Acid deposition, Deposition, Great Lakes, North America, Comparison studies, Prediction, Seasonal variation, Transport.

Precipitation chemistry observations in eastern North America in the late 1970's indicated that, when averaged over a year, the molar concentrations of SO4(2-) and NO3(-) were approximately equal (i.e. the potential contribution to the acidity from SO4(2-) was roughly twice that from NO3(-)). Not much attention was given to intra-annual variations. Four years of precipitation chemistry data for eastern North America were used to investigate seasonal and ecographical variations in vestigate seasonal and geographical variations in SO4(2-)/NO3(-) ratio. Several distinct regimes occur. One, in the region of heaviest acidic deposition extending from the states south of the Great tion extending from the states south of the Great Lakes across New England and southeastern Canada, has a very strong seasonal variation in the SO4(2-)/NO3(-) molar ratio in deposition. The ratio ranges from about 1.5 in summer to about 0.5 in winter. Another, in the smaller area of Texas and surrounding states, shows the reverse seasonal pattern. Yet another, in the high plains states, has a double maximum in the ratio in Spring and Fall. The remainder of the region has an irregular seasonal pattern. Insight into the cause of SO4(2-)/NO3(2-) variations was obtained using a simple chemical transformation of SO2 and NOx in the stmosphere is a major factor. A comparison of model predictions and observations indicate that in the vicinity of mid-western American sources the molar ratio of amount of SO2 oxidized in-cloud to that of NO2 is 0.5 in winter and 1.5 in summer. (Alexander-PTT) (Alexander-PTT) W87-04720

ALKALINE MATERIALS FLUX FROM UN-PAVED ROADS: SOURCE STRENGTH, CHEM-ISTRY AND POTENTIAL FOR ACID RAIN NEUTRALIZATION, Illinois State Water Survey Div., Champaign.

W. R. Barnard, G. J. Stensland, and D. F. Gatz. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 285-293, September 1986. 3 tab, 14 ref. NOAA Contract NA82RAC 00153.

Descriptors: *Water pollution sources, *Acid rain, *Neutralization, *Alkaline materials, *Unpaved roads, Precipitation, North America.

roads, Precipitation, North America.

Most research efforts dealing with precipitation acidity have been concerned with attempts to understand the influence of acid materials or chemical reactions leading to the formation of acids in precipitation. As a result, the role of alkaline substances in determining precipitation acidity has been largely overlooked. Precipitation acidity is a function of its contents of both acid and bases and any attempt to understand the processes causing acid precipitation must deal with the potential acid neutralizing capacity of alkaline materials. Data on the alkaline element chemistry of unpaved road surface materials and the potential flux of these elements into the atmosphere are presented. Additionally, the potential acid neutralizing capacity of unpaved road surface materials in precipitation is discussed. The relative contribution of unpaved roads to the total open source flux of alkaline materials is also examined. Preliminary calculations indicate that unpaved roads contribute more than 90% of all open source Ca and Mg in 37 and 33 of the 48 contiguous states, respectively. (Alexander-PTT) PTT 87-04721

UNCERTAINTIES IN ESTIMATING AREAL MEANS: WITH APPLICATIONS TO NADP/NTN DATA,

Illinois State Water Survey Div., Champaign.

C. P. HSU. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 295-302, September 1986. 1 fig, 3 tab, 8 ref. USGS Grant INT 14-08-001-G-964.

Descriptors: *Weather data collections, *Acid rain, *Water pollution sources, *Precipitation, *Mathematical models, *Kriging, Rainfall, Stand-ard deviation, Statistical analysis, Deposition, Con-

The National Atmospheric Deposition Program (NADP) and National Trends Network (NTN) have been gathering data to estimate mean deposi-tion of various constituents of precipitation over areas of varying size and time periods of varying length. The mean values are estimated mainly by sampling at various locations and at discrete times Such estimations introduce uncertainty about th Such estimations introduce uncertainty about the means since the samplers represent only a minute fraction of the total area to be estimated. When two or more such means are compared, some estimation of uncertainties is required to derive the statistical significance. This paper examines two methods capable of estimating such uncertainty—areal-temporal correlation and kriging approaches. These methods are applied to the NADP/NTN data, and the estimated uncertainties are compared for concentrations of nine constituents, plus conductivity and pH of the rainfall. The estimated Root Mean Square Errors (RMSE) of both methods are smaller than the non-weighted standards quetivity and pH of the rainfall. The estimated Root Mean Square Errors (RMSE) of both methods are smaller than the non-weighted standard deviation. The RMSE of the correlation approach is smaller than that of kriging for K, NH4, NO3, pH, and precipitation volume for the 3 U. S. subregions. Mixed results occur for other ions. (Author's abstract)

WET AND DRY DEPOSITION OF SULPHATES AND NITRATES IN EASTERN CANADA: 1979-1982,

1982, Atmospheric Environment Service, Downsview (Ontario).

L. A. Barrie, and A. Sirois.

Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 303-310, September 1986. 2 fig, 2 tab, 16 ref.

Descriptors: "Water pollution sources, "Wet deposition, "Dry deposition, "Sulfates, "Nitrates, "Acid rain, "Precipitation, Air pollution, Rural areas, Deposition velocity, Estimating, Reviews, Seasonal variation, Deposition.

Sources Of Pollution-Group 5B

Deposition of acidic sulfates and nitrates from the atmosphere to aquatic and terrestrial ecosystems in Canada takes place via three processes: direct uptake of particles and gases at the earth's surface (dry deposition), removal of rain and snow and fogwaster deposition. The latter two processes constitute wet deposition. Daily air and precipitation chemistry observations at six rural locations in eastern Canada were analyzed to obtain wet and dry deposition. Dry deposition was calculated from air concentrations using deposition volcities originating from a recent literature review and synthesis exercise involving land use types. Total annual deposition ranges for SO4(2-) from 10 to 86 mmol/sq m and for NO3(-) excluding NO2 contributions to dry deposition from 13 to 62 mmol/sq m. Dry deposition accounts for an estimated 22 and 21% of the total SO4(2-) and NO3(-), this fraction increases to 30% if NO2 concentration to dry deposition is included. There is a marked seasonal variation in total SO4(2-) deposition are episodic. 20% of daily events deliver between 47 and 70% of the deposition. (Alexander-PTT) W87-04723 Deposition of acidic sulfates and nitrates from the

OVERVIEW OF HISTORICAL AND PALEO-COLOGICAL STUDIES OF ACIDIC AIR POL-LUTION AND ITS EFFECTS,

LUTION AND ITS EFFECTS, Maine Univ. at Orono. Dept. of Botany and Plant Pathology. R. B. Davis, and P. M. Stokes. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 311-318, September 1986. 14 ref.

Descriptors: *Water pollution sources, *Water pollution effects, *Acid rain, *Air pollution, Acid deposition, Lake sediments, Peat, History, Paleoecology.

Historical and paleoecological studies have contributed significantly to understanding of acidic precipitation and its effects. In this overview, selected highlights of the papers that were included in the section on 'Historical Perspectives of Acidication' at the International Symposium on Acidic Precipitation in Muskoka, Ontario in 1985 are given. Historical evidence of acid deposition and its effects is summarized. This evidence consists of written records of the past chemistry and biology of atmospheric, terrestrial, and aquatic systems; it also includes evidence from archived collections which were 'revisited', from tree rings, and from the chemical and biological 'records' in lake sediment and peat from which histories of airborne contaminants and ecosystem responses to these inants and ecosystem responses to these inants were inferred. (Alexander-PTT)

REVIEW OF THE CHEMICAL RECORD IN LAKE SEDIMENT OF ENERGY RELATED AIR POLLUTION AND ITS EFFECTS ON LAKES, Maine Univ. at Orgo. Dent. of Geological Sci. Univ. at Orono. Dept. of Geological Sci-

Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 331-345, September 1986. 5 fig, 1 tab, 42

Descriptors: "Reviews, "Lake sediments, "Air pol-lution, "Water pollution sources, "Water pollution effects, "Lakes, "Sediments, Water chemistry, Ac-cumulation, Sedimentation, Pollution load, Heavy metals, Metals, Acidic lakes, Deposition, Adiron-dack Mountains, Mining.

Air pollution of urban environments has been rec-ognized for at least 130 years. Since that time awareness of regional air pollution has grown slowly. Inter-lake variation in accumulation rates slowly. Inter-lake variation in accumulation rates of energy-related elements is a function of gross sedimentation rate (sediment focusing), position on pollution gradients, and water chemistry. Accumulation rates of Pb in lake sediments from profundal area cores in the Adirondack Mountains of New York and northern New England range from 0.1 to 0.2 microgram(ug)/sq cm/y (pre-1800 A. D.) to as much as 2 ug/sq cm/y (recent sediment). Rates increase from the late 1800's to nearly the present, in parallel. Accumulation rates for V remain at

background values which range up to 0.5 ug/sq cm/y and increase 5 to 10 x background in Adirondack Mountain lakes. Chronically acidic lakes have a subsurface maximum. Of these three metals, only Pb has elevated deposition rates in high elevation lakes in the Rocky Mountains of Colorado. Mining activity is believed responsible for the implied air pollution there. (Alexander-PTT)

DIATOM-BASED PH RECONSTRUCTION STUDIES OF ACID LAKES IN EUROPE AND NORTH AMERICA: A SYNTHESIS, University Coll., London (England). Palaeoeco-

Descriptors: *Acid lakes, *Paleohydrology, *Acid rain, *Diatoms, *Water pollution effects, *Fate of pollutants, *Lake sediments, Reviews, Europe, Lakes, Sediments, Acid deposition, Deposition, Acidification, North America.

There are few acid lakes for which reliable long term pH records are available. For this reason attention has focussed on the use of fossil diatom assemblages in lake sediments as indicators of past pH trends and as a means of reconstructing past pH values. The essential features of the approach were developed prior to the recent interest in 'acid rain' but in the last few years further advances have been made. In most cases an attempt is made o establish a quantitative relationship between contemporary diatom assemblages and pH for a series of lakes along a pH gradient and to use this relationship to predict the pH represented by a fossil assemblage. There are many problems and assumptions in using this technique. The data that are now available for Europe and North America are reviewed and it is concluded that the evidence is consistent with the acid deposition hypothesis for recent lake acidification. (Alexander-PTT) W87-04727 There are few acid lakes for which reliable long term pH records are available. For this reason W87-04727

PIRLA PROJECT (PALEOECOLOGICAL IN-PIRILA PROSECT (FALEDECULOCAL IN-VESTIGATION OF RECENT LAKE ACIDIFI-CATION: PRELIMINARY RESULTS FOR THE ADIRONDACKS, NEW ENGLAND, N. GREAT LAKES STATES, AND N. FLORIDA,

Indiana Univ. at Bloomington. Dept. of Biology. D. F. Charles, D. R. Whitehead, D. S. Anderson, R. Bienert, and K. E. Camburn. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 355-365, September 1986. I fig. 4 tab, 26 ref. Electric Power Research Inst. RP-2174-10.

Descriptors: "Acid rain, "Paleoecology, "Paleohydrology, "PIRLA Project, "Lake acidification, "Sediment cores, "Fate of pollutants, "Acid lakes Lakes, Sediments, Diatoms, Air pollution, Deposition, North America, Paleoecology, History.

The PIRLA project is an interdisciplinary paleocological study designed to provide reconstructions of the recent acidification histories of a representative set of lakes in four acid-sensitive regions.

The project is trying to detersentanve set of lakes in four actid-sensitive regions in North America. The project is trying to determine if lakes in the study regions have acidified, and if so, to what extent, over what time period and why. Sediment cores from 5 to 15 lakes in and why. Sediment cores from 5 to 15 lakes in each region are being analyzed for several characteristics. Diatoms and chrysophytes are being used to reconstruct lakewater pH. Results for three Adirondack lakes with current pH of 4.8 to 5.0 indicate a decrease in pH beginning in the 1930's-1950's. Increased atmospheric deposition of strong acids appears to be the primary factor responsible for the pH decline. Two lakes (pH 4.4 and 4.7) in New England show clear evidence of acidification probably due to acidic deposition. Preliminary reconstructions for two lakes in Michigan (pH 4.4 and 5.6), one in Wisconsin (pH 5.3), and one in Minnesota (pH 6.8) suggest no recent pH decrease. For the one Florida lake (pH 4.4) analyzed, inferred pH decreases by about 0.5 unit, beginning in the 1950s; the cause has not been determined. (Author's abstract) (Author's abstract)

COMPARISON OF PALEOLIMNOLOGICAL WITH MAGIC MODEL RECONSTRUCTIONS OF WATER ACIDIFICATION Norsk Inst. for Vannforskning, Oslo.
R. F. Wright, B. J. Cosby, G. M. Hornberger, and

J. N. Galloway. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 367-380, September 1986. 6 fig, 1 tab, 29

Descriptors: *Acid rain, *Paleolimnology, *Mathematical models, *Model studies, *MAGIC model, *Water acidification, *Comparison studies, *Water pollution sources, *Water chemistry, Acidic deposition, Deposition, Estimating, Lakes, Weathering, Albalinity.

Alkalinity.

In sensitive areas receiving acidic deposition, paleolimnological data indicate changes in lake pH over 1 to 3 decades during the past century. Estimates of deposition of SOx and NOx over this same period suggest that deposition rates changed (1) earlier and (2) more slowly than did changes in lake chemistry. Clearly chemical and biological processes in the terrestrial catchment damp, delay not moderate the response of surface water pH to deposition of acidifying compounds. This response is controlled by key terrestrial processes that include chemical weathering, sulfate adsorption of all compounds, and dissolution and precipitation of Al compounds, and dissolution and dissociation of inorganic C. MAGIC (Model of Acidification of Groundwater In Catchments) provides a tool by which these processes can be simultaneously and quantitatively linked to examine the impact of acid deposition on surface water chemistry. We have applied MAGIC to 4 lakes from which paleolimnological reconstructions are available - Big Moose Lake in the Adirondacks, Loch Grannoch in Scotland, Lake Gardsjon in Sweden, and Lake Hoverst. The News The surface water such seat the seat of the surface water the surface water such as the surface water surfac Lake in the Autronacks, Loca Grannoch in Scot-land, Lake Gardsjon in Sweden, and Lake Hov-vatn in Norway. The results indicate that the proc-esses linked in MAGIC can account for temporal trends in pH and alkalinity such as those obtained from paleolimnological data. (Author's abstract) W87-04729

EVIDENCE FOR RECENT ACIDIFICATION OF LENTIC SOFT WATERS IN THE NETHER-LANDS,

LANDS, Katholieke Univ. Nijmegen (Netherlands). R. S. E. W. Leuven, H. L. M. Kersten, J. A. A. R. Schuurkes, J. G. M. Roelofs, and G. H. P. Arts. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 387-392, September 1986. 5 fig, 1 tab, 9

Descriptors: *Acidification, *Mathematical models, *Lake acidification, *Water pollution sources, Temporal variation, Water quality, Fish populations, Alkalinity, Netherlands, Lakes, Acid

Although The Netherlands are situated in the center of an acid rain area the impact of scidifying deposition on aquatic ecosystems has not been recognized at an early stage. Undoubtedly an important reason is that most surface waters are well buffered to acid additions. However, the pleistocene sandy soils in the southern and eastern parts of the country and the coastal dunes north of Bergen are highly weathered and exhibit a low acid-neutralizing capacity. Particularly in these areas many soft waters are found which seem to be highly susceptible to acidifying precipitation. Qualitative information about water acidification in The Netherlands was first obtained by comparisons of old data on diatom assemblages and macrophyte communities with recent ones. During 1983-1984 about 90% of the Dutch soft waters appeared to be acid, and 35% of them showed pH-values below 4.0. The alkalinity of most waters (70%) was less then 0.1 meq/L. Evidence for recent acidification is derived from temporal trends in water quality, Although The Netherlands are situated in the then 0.1 meq/L. Evidence for recent acidification is derived from temporal trends in water quality, fish population states, shifts in aquatic biota and application of current empirical models for lake acidification. It has been concluded that at least 59% of the Dutch soft waters have been recently acidified. This is a conservative estimate. Depending on the criterion used for assessment of acidification this percentage might be as high as 96%. (Alexander-PTT) W87-04731

Group 5B-Sources Of Pollution

NEW DATA FROM PEAT BOGS MAY GIVE A HISTORICAL PERSPECTIVE ON ACID DEPO-

Pittsburgh Univ., PA. Graduate School of Public For primary bibliographic entry see Field 2J. W87-04732

POLLUTED PRECIPITATION AND THE GEOCHRONOLOGY OF MERCURY DEPOSI-TION IN LAKE SEDIMENT OF NORTHERN

MINNESOTA, Group for the South Fork, Inc., Bridgehampton, NV

NY. S. A. Meger. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 411-419, September 1986. 2 fig. 2 tab, 19

Descriptors: *Mercury, *Lake sediments, Fate of pollutants, *Water pollution sources, *Game fish, *Wilderness lakes, *Sediment cores, *Air pollution, Watersheds, Precipitation, Lakes, Minnesota, Deposition, History, Geochronology, Heavy

Elevated Hg levels in game fish from wilderness lakes in northern Minnesota led to the present study of sediment cores from two lakes to ascertain study of sediment cores from two lakes to ascertain the source and history of Hg deposition. Natural background levels of Hg were found to range from 0.03 to 0.06 microgram(ug)/g, with cultural levels as high as 0.16 ug/g. Reconstructed geochronolo-gies reveal a dramatic two-fold increase in Hg flux, from 0.003 to 0.0017 ug/as cm/y, occurring after as high as 0.16 ug/g. Reconstructed geochronologies reveal a dramatic two-fold increase in Hg flux, from 0.008 to 0.0017 ug/sq cm/y, occurring after the year 1880, suggesting an anthropogenic influence. No industrial or geologic source of Hg is found in the study watersheds. The entire historical increase in Hg flux can be accounted for by atmospheric loading provided that 1/5 of all the Hg presently supplied to the watershed via precipitation is ultimately deposited in lake sediment. Hg levels in fish are not correlated with Hg levels in lake sediment, although there is a link to acid-sensitivity of lake water, amount of acid-neutralizing geologic material exposed in the watershed, and watershed area/lake volume ratio. Thermal stratification of lake water and complexation-adorption mechanism are proposed to account for sorption mechanism are proposed to account for variations in Hg levels observed in sediment collected from different sites. (Author's abstract) W87-04733

BIOLOGY AND CHEMISTRY OF THREE PENNSYLVANIA LAKES: RESPONSES TO ACID PRECIPITATION, Lehigh Univ., Bethlehem, P.A. Center for Marine and Environmental Studies.

For primary bibliographic entry see Field 2H. W87-04741

DISTRIBUTION OF METALS IN DIFFERENT SIZE FRACTIONS OF SEDIMENT FROM THE NIAGARA RIVER, National Water Research Inst., Burlington (Ontar-

National water Research inst., burnington (Chuario). Environmental Contaminants Div.

A. Mudroch, and G. A. Duncan.
Journal of Great Lakes Research JGLRDE, Vol.
12, No. 2, p 117-126, 1986. 2 fig. 5 tab, 11 ref.

Descriptors: *Path of pollutants, *Sediments, *Trace metals, Mineralogy, Particle size, Industrial wastes, Niagara River, Accumulation, Great Lakes, Metals.

The concentration of major and trace elements, determined in sediment samples separated me-chanically into different size fractions, gives better determined in sediment samples separated mechanically into different size fractions, gives better information for assessing a potential hazard of in situ, dredged, or resuspended sediments than the bulk total concentration. The concentrations of major elements (Si, Al, Ca, Mg, Na, K, Fe, Ti, Mn, and Ph), tand organic and carbonate C were determined in six size fractions (< 13, 13-19, 19-27, 27-40, 40-45, 45-190 micron) of bottom sediments collected at eight stations along the Niagara River. Fine particles (< 13 micron) separated from the river sediments exposed to pollution sources accumulated greater metal quantities than particles in the

other size fractions. The contribution of trace elements from specific size fractions was calculated from the particle size distribution and trace elements concentration. With the exception of Ni, significant differences were found between trace elements concentration in specific particle size fractions of Niagara River sediments and that from the nearshore zone of Lake Erie. (Author's ab-

TIDE-INDUCED LAGRANGIAN RESIDUAL CURRENT AND RESIDUAL TRANSPORT: 2. RESIDUAL TRANSPORT WITH APPLICA-TION IN SOUTH SAN FRANCISCO BAY, CALIFORNIA, Shandong Coll. of Oceanology (China). For primary bibliographic entry see Field 2L. W87-04752.

MANGANESE BIOGEOCHEMISTRY IN A SMALL ADIRONDACK FORESTED LAKE WA-Geological Survey, Doraville, GA. Water Resources Div.

J. B. Shanley. Water Resou Water Resources Research WRERAQ, Vol. 22, No. 12, p 1647-1656, November 1986. 9 fig, 3 tab, 43 ref. Electric Power Research Institute Grant

Descriptors: *Biogeochemistry, *Path of pollut-ants, *Water pollution sources, *Acid rain, *Man-ganese, *Cycling nutrients, *Forest watersheds, *Adirondack Mountains, New York, Panther Lake, Hydrogen ion concentration, Rainfall, Lake, Hydrogen ion concentration, Rainfall, Groundwater, Throughfall, Canopy, Leaching, Acidity, Soil water, Sediments, Deposition, Water-

er and October 1981, Mn conce In September and October 1981, Mn concentra-tions and pH were intensively monitored in Pan-ther Lake, New York, during two large acidic storms (each approximately 5 cm of rainfall, pH 4.61 and 4.15). The data were evaluated to identify biogochemical pathways of Mn and to assess how these pathways are altered by acidic atmospheric inputs. Concentrations of Mn averaged 1.1 micro-secution of the property of the property of the pro-cessor (up)/1 in receinitation and increased to 107 inputs. Concentrations of Mn averaged 1.1 microgram (ug)/l in precipitation and increased to 107 ug/l in canopy throughfall, the enrichment reflecting active biological cycling of Mn. Rain pH and throughfall Mn were negatively correlated, suggesting that foliar leaching of Mn was enhanced by rainfall acidity. The pulse-like input of Mn to the forest floor in the high initial concentrations in throughfall (approximately 1000 ug/l) did not affect Mn concentrations in soil water (< 20 ug/l) or groundwater (usually <40 ug/l), which varied little with time. In the inlet stream, Mn concentration remained constant at 48 ug/l as discharge varied from 1.1 to 96 l/sec. Mn was retained in the vegetative cycle and regulated in the stream by varied from 1.1 to 96 l/sec. Mn was retained in the vegetative cycle and regulated in the stream by adsorption in the soil organic horizon. The higher Mn levels in the stream may be linked to its high acidity (pH 4.2-4.3). Mixing of Mn-rich stream water with neutral lake water (pH 7.0) caused precipitation of Mn and deposition in lake sedient. (Author's abstract) /87-04754

DUAL-GAMMA ATTENTUATION FOR THE DETERMINATION OF POROUS MEDIUM SATURATION WITH RESPECT TO THREE

FLUIDS, Princeton Univ., NJ. Water Resources Program. For primarys bibliographic entry see Field 5A. W87-04755

KINETICS OF ION EXCHANGE ON NATURAL SEDIMENTS, California Univ., Davis. Dept. of Chemical Engi-

eering. ary bibliographic entry see Field 2J. For primar W87-04756

EFFECT OF RADIAL FLOW ON DEVIATIONS FROM LOCAL EQUILIBRIUM DURING SORBING SOLUTE TRANSPORT THROUGH HOMOGENEOUS SOILS,

Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.

A. J. Valocchi.

Water Resources Research WRERAQ, Vol 22, No. 12, p 1693-1701, November 1986. 5 fig, 29 ref, 2 append. NSF Grants CEE-8204434 and ECE-8418644.

Descriptors: "Path of pollutants, "Homogeneous soils, "Groundwater pollution, "Radial flow, "Soil solution, "Solute transport, Purge wells, Pumping rate, Dispersion coefficient, Distribution coefficient, Reaction rate coefficient, Desorption kinetics, Injection-extraction wells, Homogeneity, Aquifers, Breakthrough curves, Solutes, Transport

Several laboratory studies of sorbing solute transport through one-dimensionial homogeneous soil columns have recently addressed the validity of the local chemical equilibrium assumption (LEA). The present paper extends previous theoretical results to the case of ideal radial flow in homogeneous ous aquifers. Sorption kinetics are assumed to follow a first-order reversible rate law. Two follow a first-order reversible rate law. Two sample problems are considered: one involves in-jection of a contaminant pulse into a diverging radial flow field; the other, extraction of polluted groundwater by a purge well in a converging radial flow field. An analytical time moment analy-sis is performed to derive formulas for solute breakthrough curve time moments. Comparison of time moment formulas for the kinetic and equilibri-na models leads to the definition of criterios. time moment formulas for the kinetic and equilibri-um models leads to the definition of criteria of LEA validity. These criteria explicitly show the effect of basic system parameters (e.g., pumping rate, dispersion coefficient, distribution coefficient, and reaction rate coefficient) on deviations from equilibrium behavior. For the case of converging radial flow, formulas are derived to calculate the impact of desorption kinetics upon the time re-quired for aquifer decontamination. The results also show that significant nonequilibrium effects are confined to the vicinity close to the injection-extraction wells. (Author's abstract) W87-04759

CONTAMINANT TRANSPORT THROUGH A FRACTURED POROUS ROCK: IMPACT OF THE INLET BOUNDARY CONDITION ON THE CONCENTRATION PROFILE IN A ROCK MATRIX,

Royal Inst. of Tech., Stockholm (Sweden). Dept. of Chemical Engineering.

L. Moreno, and A. Rasmuson.

Water Resources Research WREFAQ, Vol. 22, No. 12, p 1728-1730, November 1986. 2 fig, 9 ref.

Descriptors: *Numerical analysis, *Geologic fractures, *Porous rock, *Concentration profiles, *Path of pollutants, *Solute transport, *Pollutants, *Rock properties, *Mathematical models, Transport, Sorption coefficients, Peclet number, Boundary conditions, Solutes, Contaminants.

In tracer tests in single fractures in fissured rock it is of interest to determine the concentration profile in the adjacent rock matrix. In this paper, concentration profiles in the rock matrix are calculated for the case of contaminant transport in a single fracture. Two different inlet boundary conditions fracture. Two different inlet boundary conditions are used: constant concentration and constant flux at the inlet of the fracture. An analytical solution is derived for the concentration in the fissure and the matrix for constant flux condition at the inlet. Concentration profiles are shown for different values of the sorption coefficient within the rock matrix and at different locations along the fracture. For low Peclet numbers, it is shown that the concentration in the matrix is strongly influenced by the inlet boundary condition. (Author's abstract) stract) W87-04762

STREAMLINE ROUTING THROUGH FRAC-TURE JUNCTIONS,
Idaho National Engineering Lab., Idaho Falls

For primary bibliographic entry see Field 2F.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Sources Of Pollution-Group 5B

LEGISLATIVE AND TECHNICAL MEANS FOR THE PREVENTION OF ACCIDENTS WITH WATER-ENDANGERING LIQUIDS, Environmental Protection Authority Grisons, For primary bibliographic entry see Field 5G. W87-04797

PLANT VIRUSES IN RIVERS AND LAKES, Biologische Bundesanstalt fuer Land- und Forstwirtschaft, Brunswick (Germany, F.R.). Inst. fuer Viruskrankheiten der Pflanzen. For primary bibliographic entry see Field 5A. W87-04821

PILOT STUDY OF SERUM POLYCHLORI-NATED BIPHENYL LEVELS IN PERSONS AT HIGH RISK OF EXPOSURE IN RESIDENTIAL AND OCCUPATIONAL ENVIRONMENTS, Centers for Disease Control, Atlanta, GA. Cente for Environmental Health. For primary bibliographic entry see Field 5C. W87-04828

PREDICTING AQUEOUS ALUMINIUM CON-CENTRATIONS IN NATURAL WATERS, e Univ. at Orono. Dept. of Botany and Plant Pathology. For primary bibliographic entry see Field 5A. W87-04834

OIL POLLUTION: A DECADE OF RESEARCH AND MONITORING, AND MONITORING, Woods Hole Oceanographic Institution, MA. Dept. of Chemistry. J. W. Farrington. Oceanus, Vol. 28, No. 3, p 3-12, Fall 1985. 4 fig, 3

Descriptors: *Water pollutions effects, *Water pollution sources, *Marine environment, *Oil pollution, *Fate of pollutants, Hydrocarbons, Marine resources, Contamination, Coastal waters, Tropical regions, Marine sediments, Oil spills, Effluents, Runoff.

A 1985 report entitled Oil in the Sea: Inputs, Fates and Effects updated a 1975 National Research Council Report and traced the long term course of oil in the marine environment and traced the effects of oil on marine organisms. Estimates for sources of petroleum hydrocarbon inputs to the marine environment are averaged in time and space, have a wide range of uncertainty and do not permit totally accurate input estimates for those portions of petroleum such as aromatic hydrocarbons known or suspected to cause adverse biological effects. The 1985 report reaffirms two important findings of the 1975 report: accidental inputs are a small fraction of the total input, and land based sources from industrial and municipal sewer effluents, marine tanker and terminal dry dock operations and urban runoff account for more than effluents, marine tanker and terminal dry dock operations and urban runoff account for more than one third of the total input. It is not yet possible to measure the rates of the major processes acting on petroleum inputs so as to make a mathematical model for the fate of petroleum from a given source. Hydrocarbon concentrations in open ocean waters have been measured by the most discriminating techniques for only a few samples. Marine sediments can be used as a rough indicator of oil contamination. The main concerns surrounding the effects of petroleum focus on two issues: human health and effects on marine resources. The report emphasizes the gaps between laboratory knowledge and field data, and expresses great concernabout the impacts of oil pollution in coastal and tropical waters. (Michael-PTT)

INFLUENCE OF SOME PHYSICO-CHEMICAL FACTORS ON CADMIUM UPTAKE BY THE PREEN ALGA STICHOCOCCUS BACILLARIS, Polish Academy of Sciences, Zabrze. Inst. of Envi-ronmental Engineering. For primary bibliographic entry see Field 5G. W87-04848

NITRATES IN GROUND AND DRINKING WATER: ANALYSIS OF POLICIES AND REG-ULATIONS, International Inst. for Environment and Society, Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W87-04854

SELENIUM AND HEAVY METALS IN SAN FRANCISCO BAY DIVING DUCKS, Patusent Wildlife Research Center, Davis, CA. Pacific Coast Field Station. H. M. Ohlendorf, R. W. Lowe, P. R. Kelly, and T. E. Harvey.

Journal of Wildlife Management JWMAA9, Vol. 50, No. 1, p 64-71, January 1986. 1 fig. 2 tab, 43 ref.

Descriptors: *Path of pollutants, *Water pollution effects, *Tissue analysis, *Selenium, *San Franciseffects, *Tissue analysis, *Selenium, *San Francis-co Bay, *Ducks, *Heavy metals, Silver Mercury, Lead, Copper, Zinc, Chromium, Nickel, Cadmium, Toxicology, Animal populations, Animal tissues.

Greater scaups and surf scoters were collected from southern San Francisco Bay and analyzed for selenium and heavy metals. There were no differseienium and neavy metais. In ere were no differences between species for liver concentrations of silver, mercury or lead. Copper and zinc levels were higher in scaups, while selenium was higher in scoters. Chromium and nickel occurred in less than 50% of the samples, and there was no difference between the two species. The geometric mean cadmium concentration in scoter kidneys was higher the in secure I have concertations of cadmium concentration in scoter kidneys was higher than in scaups. Liver concentrations of mercury and selenium were correlated. The toxicological significance of some elements in these species is not known. However, selenium levels in scoters were similar to those in livers of dabbling ducks in the nearby San Joaquin Valley where reproduction was severely impaired. (Author's abstract) W87-04856

EFFECT OF DROUGHT AND IRRIGATION ON THE FATE OF NITROGEN APPLIED TO CUT PERMANENT GRASS SWARDS IN LYSI-METERS: NITROGEN BALANCE SHEET AND THE EFFECT OF SWARD DESTRUCTION AND PLOUGHING ON NITROGEN MINER-

ALIZATION,
Agricultural Research Council, Wantage (England). Letcombe Lab. land). Letcombe Lab. C. P. Webster, and R. J. Dowdell.

Journal of the Science of Food and Agriculture JSFAAE, Vol. 37, No. 9, p 845-854, September 1986. 7 tab, 20 ref.

Descriptors: *Fertilizers, *Bioaccumulation, *Fate of pollutants, *Isotope studies, *Drought effects, *Grasses, *Lysimeters, *Nitrogen cycle, *Mineralization, *Nitrogen, Fertilization, Clays, Loam, Wheat, Leaching, Nitrous oxide, Denitrification, Rainfall, Swards.

Four years after 15N labelled fertilizer nitrogen plied to permanent grass swards growing in ter monoliths, about one-fourth remained was applied to permanent grass swards growing in lysimeter monoliths, about one-fourth remained immobilized in soil organic matter. In the intervening years, similar, but non-labelled, applications were made. Although differing rainfall regimes applied during the experiment had significantly affected nitrogen uptake by plants and nitrate loss by drainage, they caused no significant effect on tracer nitrogen remaining in the soil. Labelled nitrogen, unaccounted for in crop, drainage or soil, was presumed to have been denitrified. The ratio between estimated denitrified labelled nitrogen and annual nitrous oxide loss was about 9:1 for clay and silt loam soils. The conversion from grass to winter wheat resulted in no pronounced increase in net mineralization of labelled nitrogen, but the balance between crop uptake and the quantity leached changed. Labelled nitrogen, assimilated by wheat was less than for grass in its last year, and the quantity leached was greater than under grass swards that were supplied with an average annual rainfall distribution. Nitrous oxide emission rates following sward destruction were greater than in earlier years, but enhanced loss was of short duration. The crop clearly benefited from the succession of nitrogen applications made to grass. Wheat yield quantities exceeded national averages and

were considerably greater than for crops from lysimeters which received no nitrogen fertilizer throughout the experiment. (Author's abstract) W87-04862

IMPLICATIONS OF SEDIMENTOLOGICAL AND HYDROLOGICAL PROCESSES ON THE DISTRIBUTION OF RADIONUCLIDES: THE DISTRIBUTION OF RADIONUCIDES: THE EXAMPLE OF A SALT MARSH NEAR RA-VENGLASS, CUMBRIA, Institute of Oceanographic Sciences, Taunton

(England) (England).
A. P. Carr, and M. W. L. Blackley.
Estuarine, Coastal and Shelf Science ECSSD3,
Vol. 22, No. 5, p 529-543, May 1986. 5 fig, 43 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Sedimentology, *Hydrology, *Salt marshes, *Radioactive wastes, *Irish Sea, Electromagnetic waves, Interstitial water, Tidal effects, Clays, Erowets, Interstitial water, Inters

Sedimentological and hydrological studies were performed at a salt marsh site on the north bank of the River Esk near Ravenglass which have a bearing on the fate of the low level radioactive effluent from nearby nuclear fuel reprocessing center. A range of study techniques was used including electromagnetic distance measurement and pore water studies. Results indicate that (1) Over a two year period, there were no significant near changes; in salt studies. Results indicate that (1) Over a two year period, there were no significant net changes in salt marsh creek level, although ahort term fluctuations occurred which were attributed to expansion of clay particles during winter months. Nearby, there were vertical changes due to erosion. (2) Pore water pressures indicated a dynamic situation with very rapid responses to both tidal fluctuations and rainfall. During neap tides there was clear evidence of water seeping upwards from the underlyrainfall. During neap tides there was clear evidence of water seeping upwards from the underlying clay/sand interface. Shortlived radionuclides were detected in this zone. (3) Soil polygons, once initiated by desiccation, provided preferential routes for water and radionuclides to the subsurface sediment. These study results and others are discussed in the context of previous studies. It is concluded that the complexity of the estuarine environment results in most data being site specific. (Author's abstract) (Author's abstract) W87-04873

STATISTICAL ANALYSIS OF ESTUARINE PROFILES: III. APPLICATION TO NITRATE, NITRITE AND AMMONIUM IN THE TAMAR NITRIE ESTUARY,
Marine Biological Association of the United Kingdom, Plymouth (England).
S. Knox, M. Whitfield, D. R. Turner, and M. I.

Estuarine, Coastal and Shelf Science ECSSD3, Vol. 22, No. 5, p 619-636, May 1986. 7 fig, 4 tab, 38

Descriptors: *Path of pollutants, *Fate of pollutants, *Water pollution sources, *Water analysis, *Stuarine environment, *Nitrates, *Nitrites, *Ammonium, Nitrogen fixing bacteria, Oxidation, Nitrification, Denitrification, Sediments, Saline-freshwater interface, Simulation

Estuarine profiles of nitrate, nitrite and ammonium concentration taken over a period of six years were analyzed by a statistical procedure. While nitrate profiles indicate conservative mixing, those of nitrite and ammonium exhibit maxima indicative of an estuarine input. Calculations using an advective analog suggest that production of nitrite by oxidation throughout the water column would require unduly high populations of nitrifying bacteria. Sedimentary production rates required to sustain the observed nitrite maxima are compatible with combined nitrification and denitrification rates observed eisewhere. The relative displacement of the bined nitrification and denitrification rates ob-served elsewhere. The relative displacement of the nitrite and ammonium maxima and the frequent presence of a turbidity maximum in the Tamar estuary suggest that nitrite production in the sedi-ment is probably augmented by water column ni-trification in the region of the freshwater/brackish water interface. Simulations on the advective analog provide cicumstantial support for this sug-gestion. (Author's abstract)

Group 5B-Sources Of Pollution

WX7.04874

ANAEROBIC BACTERIAL DISSOLUTION OF LEAD OXIDE, Brookhaven National Lab., Upton, NY. Dept. of Applied Science.

A J. Francis, and C. J. Dodge.
A J. Francis, and C. J. Dodge.
A J. Francis, and C. J. Dodge.
A Chives of Environmental Contamination and Toxicology AECTCV, Vol. 15, No. 6, p 611-616, 1986. 4 fig. 4 tab, 20 ref. Contract DE-AC02-76CH00016.

Descriptors: *Path of pollutants, *Heavy metals, *Toxic wastes, *Anaerobic digestion, *Lead oxide, *Microbial degradation, *Bacteria, Galena, Organic acids, Hydrogen ion concentration, Biomass, Polymers, Coal cleaning wastes, Solubility.

An anaerobic bacterium isolated from coal cleaning waste solubilized a significant amount of lead oxide (PbO), and to a lesser extent PbSO4, but not Pbo, PbS and galena. The rate of Pb dissolution during logarithmic growth of the bacteria in 40 millilitiers of medium containing 3.32 micromoles of PbO was 0.042 micromoles per milliliter per hour. Dissolution of PbO by the bacteria was due production of organic acids and lowering of the pH of the growth medium. The solubilized metal was bioavailable to the organism as evidenced by lead associated with cell biomass as well as immobilization by a polymer-like substance produced by the organism. These results suggest that under appropriate conditions microbial dissolution of PbO could be significant in the environment. (Author's abstract)

STUDIES ON THE ENVIRONMENTAL FATE OF CARBARYL AS A FUNCTION OF PH, Ohio State Univ., Columbus. Dept. of Entomolo-

gy. For primary bibliographic entry see Field 5C. W87-04876

HEALTH IMPACT OF ACIDIC DEPOSITION, World Health Organization, Copenhagen (Den

For primary bibliographic entry see Field 5C. W87-04870

WET DEPOSITION OF POLYCYCLIC AROMATIC HYDROCARBONS IN THE NETHER-

LANDS, Rijksinstituut voor de Volksgezondheid en Milieu-hygiene, Bilthoven (Netherlands). Lab. for Ecolo-gy, Water and Drinking Water. H. Den Hollander, D. Van de Meent, P. Van Noort, and E. Wondergem. The Science of the Total Environment STENDL, Vol. 52, No. 3, p 211-219, July 1986. 2 fig, 2 tab, 6

Descriptors: *Water pollution sources, *Water analysis, *Polycyclic aromatic hydrocarbons, *Netherlands, *Deposition, *Acid rain, Aerosols, Adsorption, Phenanthrane, Scavenging, Belgium, Germany, Solubility.

Concentrations of 11 polycyclic aromatic hydro-carbons (PAH) in rainwater sampled from four locations in the Netherlands were quantified. Scav-enging ratios were calculated from literature data for these PAH in air. Scavenging ratios were de-termined for PAH predominantly adsorbed on aer-cools and for phenanthrene. Data for the aerosol-associated PAH were characterized in terms of aerosol incloud acayenging and compared with associated PAH were characterized in terms of aerosol in-cloud scavenging and compared with reported data from Belgium and Germany. The scavenging ratios for phenanthrene were compared with those predicted on the basis of the Henry's law constant and were found to be less than one order of magnitude higher than expected, possibly because of enhanced aqueous solubility. (Author's abstract) W87-04880

POINT-SOURCE INPUTS OF PETROLEUM WASTEWATER INTO THE NIGER DELTA, NI-

Rivers State Univ. of Science and Technology, Port Harcourt (Nigeria). Inst. of Pollution Studies. D. D. Ibiebele.

The Science of the Total Environment STENDL, Vol. 52, No. 3, p 233-238, July 1986. 1 fig, 1 tab, 15

Descriptors: *Oil refineries, *Water pollution sources, *Water analysis, *Oil wastes, *Estuaries, *Oil pollution, Hydrocarbons, Niger River, Nigeria, Oil industry, Oily water.

ria, Oil industry, Oily water.

A study was conducted to estimate the quantities of petroleum wastewater and hydrocarbon inputs from oil exporting terminals and refineries which dewater crude petroleum and discharge the wastewater into the delta system of the Niger River in Nigeria. The concentrations of oil dissolved in the wastewater were also determined. The average quantities of crude oil delivered to refineries and terminals between 1980 and 1983 were used to estimate the quantity of petroleum wastewater discharged at each station. Results showed that an average of 87.9 million cubic meters of oil was produced in Nigeria each year between 1980 and 1983 and 86.2% of this was exported and locally refined which generated an average of 12.9 cubic meters of wastewater each year. The concentration of oil dissolved in the water ranged from 11.2 to 53.9 mg/L (0.14 to 0.7 tons of oil). Based on these results, more ecological studies on the impact of chronic oil discharge on marine resources are required. (Author's abstract) W87-04881

INTERACTION OF CERTAIN HEAVY METALS WITH LAKE HUMIC ACIDS, Kashmir Univ., Srinagar (India). Centre of Research for Development.
R. A. Kango, D. P. Zutshi, K. P. Dubey, and M. V. M. Desai.

International Journal of Environmental Analytical Chemistry IJEAA9, Vol. 26, No. 1, p 51-59, 1986.

Descriptors: *Water chemistry, *Path of pollutants, *Heavy metals, *Humic acids, *Lakes, *India, *Isotope studies, Calcium, Zinc, Iron, Manganese, Solubility, Spectrophotometry, Isotopes, Ion ex-

Studies were conducted to investigate the interac-tion properties of humic acids with certain heavy metals such as Ca, Zn, Fe and Mn by using their isotopes. Sediment samples were collected in pes. Sediment samples were collected in her from four Indian lakes. Humic material summer from four Indian lakes. Humic material was siolated and humic acids were precipitated. Interaction of humic acids was studied with calcium, iron, zinc and manganese isotopes. Ca(2+) and Zn(2+) were complexed by humic acid in non-cationic forms at about 5-10% and 1-10%, respectively. Although the percentage of solubilized Ca and Zn was high, the complexed fractions were low. In the Fe(3+) and Mn(3+), the percent cubulitized was low, but complexition was high. solubilized was low, but complexation was high (66-90%). Calcium and zinc were solubilized more because of the ionic nature of of their linkages with humic material. Solubilization reactions were in agreement with another observation of a two fold increase in solubilization by zinc over manganese. Results suggest that about 66% of the solubilized manganese was held up in non-cationic complex form. (Michael-PTT) W87-04884

POLYCYCLIC AROMATIC HYDROCARBONS IN SURFACE SEDIMENTS FROM THE ELIZA-

BETH RIVER SUBESTUARY,
William and Mary Coll., Gloucester Point, VA.
Inst. of Marine Science.
For primary bibliographic entry see Field 5A.
W87-0485

LOW-LEVEL RADIOACTIVITY IN THE IRISH SEA, J. H. W. Hain

Oceanus OCEAAK, Vol. 29, No. 3, p 16-26, Fall 1986. 7 fig, 8 ref.

Descriptors: *Water pollution sources, *Waste disposal, *Water analysis, *Radioactivity, *Irish Sea,

*Nuclear powerplants, *Radioactive wastes, *Radioactive waste disposal, *Sediments, *Path of pollutants, Nuclear fuel reprocessing, Fish, Shellfish, Seaweed, Bioaccumulation, Radioactivity effects.

The Irish Sea has been characterized as one of the most radioactive seas in the world, largely as a result of sea discharges from the Sellafield nuclear fuel reprocessing plant. This plant is one of the fuel reprocessing plant. This plant is one of the world's largest reprocessing centers and contains the oldest operating commercial nuclear power-plant. The plant has experienced recurring radiation incidents. A thermal oxide reprocessing plant scheduled for completion in 1992 may replace the aging technology currently in use at Sellafield, but will not solve the continuing problem of the radio-active wastes generated by fuel reprocessing. Sed discharges from Sellafield contain a suite of radio-active components that vary in composition and discharges from Sellafield contain a suite of radio-active components that vary in composition and quantity. Soluble radionuclides in the discharges have an Irish Sea residence time of about two years. Sediments have become the sink for non-soluble components of Sellafield discharges. Radi-onuclide bearing sediments are viewed as the most significant pathway to man. Seaweed, fish and shellfish have been identified as critical pathways for cesium-137 and ruthenium-106. The Sellafield discharge problem has both regional and global implications in determining cumulative effects and formulating policy governing disposal of radioac-tive wastes. (Michael-PTT)

ARCTIC OCEAN POLLUTION, Alaska Univ., Fairbanks. Inst. of Marine Science. V. Alexander. Oceanus OCEAAK, Vol. 29, No. 1, p 31-35, Spring 1986. 2 tab. 11 ref.

Descriptors: *Path of pollutants, *Arctic Ocean, *Pollution load, *Water pollution sources, *Arctic, Municipal wastes, Oil pollution, Offshore platforms, Plastics, Mine wastes.

Long distance transport of pollutants and increased development of local resources has caused an in-crease in the levels of pollution of the arctic envidevelopment of local resources has caused an increase in the levels of pollution of the arctic environment from a variety of sources. Sewage discharge could cause serious pollution should the population grow substantially along the coast, and sewage discharge is currently a problem in the Baltic Sea. Oil and industrial development in the U.S. and Canadian coastal regions will increase and affect the coastal marine system. Although no serious spills have occurred, oil exploration and offshore production constitute potential risks. Soviet arctic mining operations probably result in river transport of heavy metals to the Arctic Ocean. Accumulating plastic material is likely to become an increasing hazard to arctic seabirds and seals. It is evident that industrially produced contaminants are transported over long distances and have reached the Arctic Sea area. The Baltic Sea has experienced severe pollution problems due, in part, to the very low rates of water exchange between the Baltic and other seas. The question of whether arctic marine ecosystems are particularly vulnerable to pollution because of climate extremes and slow turnover of biomass has yet to be answered. (Michael-PTT)

EFFECTS OF SOIL CONTAMINATION WITH COPPER, LEAD AND ARSENIC ON THE GROWTH AND COMPOSITION OF PLANTS: IL EFFECTS OF SOURCE CONTAMINATION, VARYING SOIL PH, AND PRIOR WATER-

amonwealth Scientific and Industrial Research anization, Glen Osmond (Australia). Div. of

For primary bibliographic entry see Field 5C. W87-04896

EFFECTS OF SALINITY AND TEMPERATURE ON THE IN VITRO METABOLISM OF THE ORGANOPHOSPHORUS INSECTICIDE FENI-TROTHION BY THE BLUE CRAB, CALLIN-ECTES SAPIDUS, Florida Univ., Gainesville. Dept. of Food Science

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Sources Of Pollution-Group 5B

and Human Nutrition.

J. J. Johnston, and M. D. Corbett.

Pesticide Biochemistry and Physiology PCBPBS,
Vol. 26, No. 2, p 193-201, October 1986. 1 fig. 6

Descriptors: "Water pollution effects, "Salinity, "Temperature effects, "Metabolism, "Organophosphorus pesticides, "Fenitrothion, "Crabs, "Insecticides, "Fate of pollutants, "Toxicity, Pesticide toxicity, Organophosphorus compounds, Crustaceans, Enzymes, Animal physiology, Animal metabolism, Acclimatization.

The in vitro metabolism of fenitrothion by subcellular fractions prepared from the hepatopancreas of blue crabs, Callinectes sapidus, was investigated. Fenitrothion was metabolized to fenitroxon and 3-methyl-4-nitrophenol in the microsomal fraction and to desmethyl fenitrothion in the cytosolic fraction. The rates of formation of 3-methyl-4-nitrophenol and desmethyl fenitrothion were greater in subcellular fractions prepared from crabs which had been acclimated to lower salimity seawater. The rate of formation of the more toxic metabolite fenitroxon was greater in the microsomal fraction The rate of formation of the more toxic metabolite fenitrooxon was greater in the microsomal fraction prepared from crabs which had been acclimated to higher salinity water. All three metabolites were formed at considerably faster rates in subcellular fractions from crabs acclimated to and incubated at 22 than at 17 C. These results suggest that enzyme activity contributes to the increased in vivo toxicity of fenitrothion to blue crabs at elevated salinities and temperatures. Also, the observed differences in the rate of formation of the oxon have a greater effect on toxicity than differences in the rate of formation of 3-methyl-4-mitrophenol and desmethyl fenitrothion. (Author's abstract)

EFFECTS OF SIMULATED ACIDIC RAIN ON WASH-OFF OF FUNGICIDES AND CONTROL OF LATE BLIGHT ON POTATO LEAVES, Boyce Thompson Inst. for Plant Research, Ithaca, NY.

For primary bibliographic entry see Field 5C.

WATER CONTAMINATION CAUSED BY GAS-OLINE PERMEATING A POLYBUTYLENE

ssee Water Quality Lab., FL.

I alianassee Water Quality Lab., F.L.
W. G. Leseman.
Journal of the American Water Works Association
JAWWA5, Vol. 78, No. 11, p 39-43, November
1986. 4 fig. 3 tab, 5 ref.

Descriptors: *Water pollution sources, *Water pollution prevention, *Casoline, *Pipes, *Water quality management, *Leakage, Water transport, Drinking water, Potable water, Organic compounds, Tallahassee.

A water quality complaint received by the city of Tallahasaee, FL resulted in an investigation that found contamination of a service line caused by gasoline leaking into the soil surrounding the pipe. The service connection to an apartment was the only incidence of the contamination, but levels of 1,2-dibromoethane in one apartment were found to 80 times the limit set by the Florida Department of Environmental Regulations. The service line was replaced with copper pipe, which solved the problem. It is recommended that utilities maintain records of the date and type of water mains and service connections installed, and that a thorough check of the ground surface be undertaken in response to complaints. When polybutylene pipe has been installed by the customer himself, the tuility will have no record of it. The pipe and contaminated soil should then be removed, the customer's lines flushed, and samples collected to ensure that no residual organic contamination remains in the lines. (Author's abstract)

HEAVY METALS DISTRIBUTION IN THE MOUTH OF THE BESOS AND LLOBREGAT RIVERS (DISTRIBUCION DE METALES PESADOS EN LAS DESEMBOCADURAS DE LOS

RIOS BESOS Y LLOBREGAT (MEDITER-RANEO OCCIDENTAL), Instituto de Investigaciones Pesqueras de Barcelo-na (Spain). X. Modamio.

Investigacion Pesquera IPESAV, Vol. 50, No. 2, p 203-211, June 1986. 6 fig, 1 tab, 13 ref.

Descriptors: *Sediments, *Path of pollutants, *Distribution, *Heavy metals, *Estuaries, *Barcelona, *Pollutant identification, *Chemical analysis, Water analysis, Rivers.

water analysis, Rivers.

Sediments from the mouth of the Besos and Llobregat rivers near Barcelona, Spain were analyzed for heavy metal distribution. At Besos, Hg ranged from 16.4 to 0.16 microgram/gram, and Pb ranged from 50.2 to 46.5 microgram/gram. Gradients were less marked for Cr. Cu, and Cd. At the Llobregat River, Hg levels ranged from 0.2 to 9.66 microgram/gram, with lower levels at the mouth of the river and the higher levels further out. Pb and Cr showed a similar distribution; Pb levels ranged from 4.8 to 242.5 microgram/gram, and Cr levels ranged from 19.1 to 91.5 microgram/gram. Cu levels ranged from 19.2 to 166.7 microgram/gram, with the highest levels around the port of Barcelona. Cd levels were correlated with the influence of the river, ranging from 0.24 to 0.63 microgram/gram. It is concluded that the metal distribution is influenced by contributions of the Barcelona harbor and the Zona Franca collecting waters system. (Doria-PTT)

AMMONIFICATION'S ACTIVITY IN SEA-WATER AND SEDIMENTS OF THE CADIZ BAY (SW SPAIN) (AMONIFICACION EN AGUAS Y SEDIMENTOS MARINOS DE LA BAHLA DE CADIZ (SO DE ESPANA)), Instituto de Ciencias Marinas, Andalucia (Spain). J. Blasco, R. Establier, V. Flores, and A. Gomez. Investigacion Pesquera PIESAV, Vol. 50, No. 2, p 297-307, June 1986. 3 fig, 1 tab, 25 ref.

Descriptors: *Water pollution effects, *Path of pollutants, *Water chemistry, *Ammonification, *Bays, *Cadiz, *Marine sediments, *Seasonal variation, *Sea water, *Sediments, Hydrology, Distribution, Nitrates, Nitrites, Acidity, Oxygen, Dissolved oxygen, Ammonia, Clays, Soil types.

Ammonification in the water and sediment of 13 sampling stations from the Bay of Cadiz (SW Spain) and its channels was determined in different seasons, along with temperature, pH, salinity, dissolved oxygen, ammonia, nitrates, and nitrites. No significant differences in ammonification activity significant differences in ammonification activity were found between seasons. A positive correlation was found between organic nitrogen and ammonification in autumn and spring. The highest rate of ammonification was found in clay sediments. (Doria-PTT)
W87-04915

CHEMICAL AND PHYSICAL ENRICHMENTS OF SEDIMENT FROM CROPLAND, Agricultural Research Service, Morris, MN. R. A. Young, A. E. Olness, C. K. Mutchler, and W. C. Moldenhauer.

Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 165-169, January-February 1986. 6 fig. 2 tab, 19 ref.

Descriptors: *Path of pollutants, *Soil erosion, *Enrichment, *Sediments, *Enriched sediments, *Cropland, *Soil loss, *Nutrients, *Erosion, Chemical properties, Physical properties, Particle size, Clays, Silts, Adsorption, Transport, Hydrology, Rainfall simulators, Soil types, Soil texture, Water-

The United States is losing soil from its agricultural lands at excessive rates, averaging nearly 10.75 tons of soil per hectare per year by water erosion and 7.4 vha-yr by wind erosion from cultivated cropland. Soil loss tolerances are exceeded on about 44% of the total cropland in the country. Loss of soil and plant nutrients resulting from the erosion process is a significant factor in decline of soil productivity. The erosion process is recog-

nized as being selective in both physical and chemical properties. Smaller size particles, particularly clay and silt, adsorb and transport large quantities of nutrients due to their relatively greater specific surface area. Selectivity of the erosion process is more pronounced for the more numerous but less severe hydrologic events since these events result in a disproportionate amount of smaller particles being transported from a site. Thus, nutrient enrichments are complex and tend to vary inversely with suspended sediment concentrations. Soil and nutrient losses from simulated rainstorms on texturally similar soils at three widely separated locations in the upper, mid and lower Missiasippi River watershed were examined. Physical characteristics of the sediment, including aggregate size distributions and primary particle size distributions, and selected chemical properties are discussed in relation to soil productivity. Enrichments in sediment to total Kjeldahl nitrogen, organic carbon, cation exchange capacity and available nitrogen are related to sediment characteristics and clay enrichment. (Alexander-PTT)

MANAGING FEEDLOT RUNOFF WITH A SET-TLING BASIN PLUS TILED INFILTRATION

nce and Education Administration, Coshocton,

For primary bibliographic entry see Field 5G. W87-M937

GROUP INVARIANCE AND FIELD-SCALE SOLUTE TRANSPORT,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.

vironmental sciences. G. Sposito, and W. A. Jury. Water Resources Research WRERAQ, Vol. 22, No. 13, p 1743-1748, December 1986. 2 tab, 18 ref. NSF Grant ECE 85-13726.

Descriptors: *Path of pollutants, *Solute transport, *Mathematical equations, *Dispersion, *Convection, Probability distribution, Vadose zone, Vadose water, Boundary conditions.

water, Boundary conditions.

The conventional measurement and statistical characterization of solute dispersion coefficients and convection velocities in a field-scale vadose zone are based on the assumption that the convection-dispersion equation governs solute transport locally. The implications of this hypothesis are investigated mathematically through a study of the space and time coordinate transformations which leave the one-dimensional convection-dispersion equation (CDE) invariant in form. It is shown that there are just six nontrivial space-time transformations under which this CDE is invariant. The pioneering field-scale leaching experiment reported by Biggar and Nielsen is used to make a typical application of these results. When the boundary condition in the Biggar-Nielsen experiment is imposed, the number of possible space-time transformations of the CDE reduces to two, one of which is a scaling transformation related closely to scale transformations of the solute transport coefficients. These results and the assumption that sets of transport coefficients corresponding to widely separated regions in a vadose zone are statistically independent are sufficient to prove that the field-wide probability distribution of the transport coefficients. ed regions in a vadose zone are statistically inde-pendent are sufficient to prove that the field-wide probability distribution of the transport coefficients (taken as random variables) will be lognormal. The methodology developed in this study can be ap-plied to any field-scale solute transport phenome-non for which the partial differential equation gov-erning solute movement locally is assumed known. (Author's abstract) erning solute moves (Author's abstract) W87-04940

DIRECT DISTRIBUTION MODEL FOR RE-GIONAL AQUATIC ACIDIFICATION, Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering. M. J. Small, and M. C. Sutton. Water Resources Research WRERAQ, Vol. 22, No. 13, p 1749-1758, December 1986. 15 fig, 1 tab,

Descriptors: *Mathematical models, *Acid rain, *Acidification, *Acid deposition, *Water pollution

Group 5B-Sources Of Pollution

effects, *Weathering, *Lakes, *Fish, New York, Alkalinity, Prediction, Hydrogen ion concentra-

The processes affecting acidification of aquatic systems are complex. Important factors include the hydrology and geochemistry of the watershed, soil processes such as weathering, ion exchange, and adsorption, plant uptake, and chemical and biological reactions in the receiving lake or stream. Damage to fisheries likewise involves complex mechanisms, including the impairment of reproduction, damage to young fish and resulting reductions in recruitment, direct kills during pH-depresion/metals-elevation events, and losses realized through the food chain. Dynamic, mechanistic models have been developed to simulate acidification processes with varying degrees of detail and sophistication. A model is developed to predict the regional distribution of lake acidification and its effect on fish survival. The model predicts the effect of changes in acid deposition rates on the mean and variance of the regional distribution of lake alkalinity is represented by a three-parameter lognormal distribution. The regional distribution of lake alkalinity is represented by a three-parameter lognormal distribution. The regional by the distribution is derived using an explicit pH-alkalinity relationship. The predicted pH distribution is combined with a fish presence-absence relationship to predict the fraction of lakes in a region of New York State. Significant needs for future research for regional aggregation of aquatic acidification models are identified. (Alexander-PTT) PTT) W87-04941

SOLUTE TRANSPORT PARALLEL TO AN

SOLUTE TRANSPORT PARAILIEL TO AN INTERFACE SEPARATING TWO DIFFERENT POROUS MATERIALS,
Technische Hogeschool Delft (Netherlands). Onderafdeling der Wiskunde en Informatica.
C. J. van Duijn, and S. E. A. T. M. van der Zee. Water Resources Research WRERAQ, Vol. 22, No. 13, p 1779-1789, December 1986. 10 fig. 1 tab, 28 ref.

Descriptors: *Solute transport, *Groundwater movement, *Path of pollutants, *Interfaces, *Porous media, *Flow domain, Adsorption, Per-meability, Boundary conditions, Breakthrough curves, Numerical analysis, Dispersion, Solutes,

Transport.

The transport of solute in groundwater is the result of convection, diffusion, dispersion, and retarding mechanisms such as adsorption. The mathematical formulation of miscible displacement in porous media is given by the convection-dispersion equation. Often a major factor that limits the predictive capability of this equation is the heterogeneity of porous media. This problem has motivated a number of studies dealing with the effect of heterogeneity on transport. Since it is recognized that the size of the flow domain is of importance, the effect of heterogeneity has been studied on several scales. The transport of solute is studied for a flow domain consisting of two regions that are separated by a sharp interface parallel to the direction of water flow. The two regions have different flow velocities, linear adsorption coefficients, and porosities. An approximate analytical solution is given for the depletion of solute in the most permeable region caused by transfer of solute into the less permeable region. To take into account the boundary conditions at the interface, an approximate expression is derived for the concentration at the interface. In the derivations the longitudinal dispersion coefficient is assumed to be zero, and the transversal dispersion coefficient is taken finite. persion coefficient is assumed to be zero, and the transversal dispersion coefficient is taken finite. For comparison to numerical results, an expression For comparison to numerical results, an expression for the concentration averaged over the height in the permeable region, at given distance and time, is presented. The agreement of numerically obtained breakthrough curves and interface concentrations with the analytical results is shown. Because of the zero longitudinal dispersion coefficient in the analytical approach, differences occur at initial breakthrough. Agreement between numerical and analytical results is good after initial breakthrough

provided the assumption of two infinitely thick regions is valid. Lower bound constraints for the thickness of the two regions are given. The assumption made often of infinite transversal dispersion leads to significant differences compared to numerical results in the case of a large retardation factor R sub 2 in the region with the smallest transport velocity. (Alexander-PTT) W87-04943

MODEL TO EVALUATE THE TRANSIENT HYDRAULIC RESPONSE OF THREE-DIMEN-SIONAL SPARSELY FRACTURED ROCK

Pennsylvania State Univ., University Park. Dept. of Mineral Engineering.

D. Elsworth.
Water Resources Research WRERAQ, Vol. 22, No. 13, p 1809-1819, December 1986. 11 fig, 24 ref. DOI Grant 91154142.

Descriptors: "Groundwater movement, "Finite element analysis, "Mathematical models, "Rock properties, "Path of pollutants, "Geologic fractures, "Transient flow, Mathematical equations, Calibrations, Rock masses, Fissures.

The utilization of sparsely fractured rock masses as a potential host for highly toxic wastes has highlighted the inability of current characterization methods to describe adequately the hydraulic response. To date, groundwater hydrogeologists have been concerned primarily with aquifers of high yield where existing continuum and dual porosity models are found to perform adequately. In sparsely fractured formations, however, these models are markedly deficient, and alternative treatment of the problem is required. Use of discontinuum models incroporating discrete fractures treatment of the problem is required. Use of dis-continuum models incorporating discrete fractures is plagued with problems related to both the validi-ty and quality of input data and the computational effort required to evaluate responses for even rela-tively modest realizations of fracture density. A numerical model is presented for the analysis of transient fluid flow in large systems of rigid fissure discs. A boundary element procedure is invoked to discs. A boundary element procedure is invoked to minimize the number of equations required to define the system. Condensation of the system of equations at an elemental or individual disc level is used to cast the solution into finite element format. used to cast the solution into finite element format. The resulting global matrices are well conditioned, sparsely populated, and apparently symmetric. The formulation performed well in validation studies for both single unconnected and multiply connected fissures. The procedure is ideally suited to the analysis of large, formerly intractable, fissure networks where the system degrees of freedom may be reduced to and retained at a minimum. (Alexander, PTT) der-PTT)

GROUNDWATER CONTAMINATION FROM AN INACTIVE URANIUM MILL TAILINGS PILE: 2. APPLICATION OF A DYNAMIC MIXING MODEL, California Univ., Berkeley. Lawrence Berkeley

T. N. Narasimhan, A. F. White, and T. Tokunaga. Water Resources Research WRERAQ, Vol. 22, No. 13, p 1820-1834, December 1986. 20 fig. 3 tab, 24 ref. DOE Contract DE-AC03-765F00098.

Descriptors: *Groundwater pollution, *Mining wastes, *Mathematical models, *Dynamic mixing, *DYNAMIX, *Uranium mills, *Path of pollutants, *Water pollution sources, *Process water, Aquifers, Infiltration, Flow, Ggoundwater, Calibrations

At Riverton, Wyoming, low pH process waters from an abandoned uranium mill tailings pile have been infiltrating into and contaminating the shallow water table aquifer. The contamination process has been governed by transient infiltration rates, saturated-unsaturated flow, as well as transient chemical reactions between the many chemical species present in the mixing waters and the sediments. In the first part of this two-part series field data as well as an interpretation based on a static mixing model were presented. As an upper bound, it was estimated that 1.7% of the tailings

water had mixed with the native groundwater. In the present work the results of numerical investiga-tion of the dynamic mixing process are presented. The model, DYNAMIX (DYNAmic MIXing), the model, DVNAMIX (DVNAmic MIXing), couples a chemical speciation algorithm, PHREQE, with a modified form of the transport algorithm, TRUMP, specifically designed to handle the simultaneous migration of several chemical constituents. The overall problem of simulating the evolution and migration of the contaminant plume was divided into three sub problems that were solved in sequential stages. These were the infiliration problem, the reactive mixing problem, and the plume-migration problem. The results of the application agree reasonably with the detailed field data. The methodology developed in the present study demonstrates the feasibility of analyzing the evolution of natural hydrogeochemical systems through a coupled analysis of transient fluid flow as well as chemical reactions. It seems worthwhile to devote further effort toward improving the physicochemical capabilities of the model as well as to enhance its computational efficiency. (Author's abstract)

SIMULATION OF CONTAMINANT PLUMES WITH LARGE DISPERSIVE CONTRAST: EVALUATION OF ALTERNATING DIREC-TION GALERKIN MODELS,

TION GALERKIN MODELS, Waterloo Univ. (Ontario). Dept. of Earth Sciences. E. O. Frind, and D. Germain. Water Resources Research WRERAQ, Vol. 22, No. 13, p 1857-1873, December 1986. 15 fig, 2 tab, 26 ref. NSERC (Canada) Grant A8368.

Descriptors: *Groundwater movement, *Contaminant plumes, *Dispersion, *Mathematical models, *Galerkin models, *Simulation, *Path of pollutants, Plumes, Groundwater, Comparison studies.

The understanding of contaminant migration in groundwater has taken a major step forward with the publication of a number of highly detailed field studies. Most of the plumes studied originate at surface sources and migrate along shallow surficial aquifers. They are generally of a thin elongated shape, sharply defined above and below, spreading very little in the vertical direction. Even in the horizontal, transverse spreading appears to be horizontal, transverse spreading appears to be small and of a nature that could be explained by a small and of a nature that could be explained by a divergent flow field. The evolution of narrow, sharply defined contaminant plumes, correspond-ing in shape to those often observed in the field, was examined. The transverse dispersion mecha-nism consistent with such shapes can be as low as of the order of molecular diffusion; dispersivity contrasts of as much as 4 orders of magnitude are possible. Even at the lowest physically realistic possible. Even at the lowest physically realistic values of transverse dispersion parameters, transverse mass spreading is capable of significantly retarding the advance of the plume front. The principal direction and alternating direction Galerkin models together are capable of handling all cases of dispersive contrast including those with dispersivity ratio of infinity. The models were formulated in curvilinear coordinates with certain restrictions on the element deformation. A three-way comparison between principal direction, alterrestrictions on the element deformation. A three-way comparison between principal direction, alter-nating direction Galerkin, and conventional finite element models was performed with respect to accuracy and efficiency. The effects of longitudi-nal and transverse numerical dispersion occurring in the various models were examined and related to the discretization. (Alexander-PTT) W87-04949

VELOCITY-DEPENDENT HYDRODYNAMIC DISPERSION DURING UNSTEADY, UNSATU-RATED SOIL WATER FLOW: EXPERIMENTS, Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Soils. W. J. Bond. Water Resources Research WRERAQ, Vol. 22, No. 13, p 1881-1889, December 1986. 5 fig, 2 tab,

Descriptors: *Soil water movement, *Hydrodynamic dispersion, *Unsaturated flow, *Solute transport, *Path of pollutants, *Mathematical models, *Soil water, Flow, Solutes, Sand, Absorp-

Sources Of Pollution-Group 5B

ion, Pore water, Breakthrough, Dispersion, Ve-

An understanding of the way that solutes are transported in soils is essential to the development of sound strategies for managing solutes in the environment, both the desirable ones such as fertilizers as well as the undesirable ones that lead to salinization of soil or pollution of groundwater. The effect of the velocity dependence of the hydrodynamic dispersion coefficient on solute movement and distribution during unsteady flow of water in unsaturated soils is described mathematically and experimentally. Approximate analytical solutions of the solute transport equation are presented for velocirated soils is described mathematically and experimentally. Approximate analytical solutions of the solute transport equation are presented for velocity-dependent dispersion during constant potential and constant flux horizontal absorption, subject to a step change in solute concentration and a pulse input of solute, respectively. Discussion is confined to the case where there is no chemical interaction between the solute and the soil and no soil water that is inaccessible to the solute. Experiments were designed to demonstrate velocity-dependent dispersion and were carried out with a fine sand for the conditions outlined above. The effect of the velocity dependence of the dispersion coefficient was to cause the spread in the concentration profile to be greater that would have been expected if there was no velocity dependence. This effect is large at small times and decreases with increasing time for constant potential absorption. During constant flux absorption the magnitude of the effect depends largely on the magnitude of the input flux, increasing as the flux increases, but it also increases slightly with increasing time. The relationship between the dispersion coefficient and pore water velocity was measured for this fine sand by means of steady, saturated breakthrough experiments. This independently measured relationship was then used in the approximate analytical solutions to predict the observed concentration profiles from the unsteady experiments. Very good agreement was found. (Alexander-PTT)

PARTICLE TRANSPORT THROUGH POROUS

MEDIA, California Univ., Berkeley. Dept. of Civil Engi-

L. M. McDowell-Boyer, J. R. Hunt, and N. Sitar. Water Resources Research WRERAQ, Vol. 22, No. 13, p 1901-1921, December 1986. 5 fig. 1 tab, 176 ref. Water Resources Center Project UCAL-

Descriptors: *Solute transport, *Suspended load, *Particle transport, *Porous media, *Path of polutants, *Mathematical models, *Model studies, *Groundwater movement, *Permeability, Field tests, Viruses, Bacteria, Pores, Adsorption, Radionuclides, Filtration.

tests, Viruses, Bacteria, Pores, Ausorpiton, Radionuclides, Filtration.

The fate of many pollutants in the aquatic environment is determined by the fate of the particulate matter with which they are associated. The transport and bioavailability of hydrophobic organics and toxic metals, for example, depends on the degree of partitioning of these compounds between solution and solid phases. The solid phase consists of both stationary and mobile, or suspended, states. Transport of suspended particulate matter is widely recognized to occur in subsurface environments. Field data indicate that viruses, bacteria, and clay minerals can migrate considerable distances and that small particles and macromolecules are implicated in the transport of organic contaminants and radionuclides. Media permeability can be significantly altered by changes in aqueous chemistry through particle release and capture. Quantitative models for predicting particle transport are available within the water filtration literature that account for the mechanisms of particle-media collisions and the conditions for attachment. Predictions from the filtration models are used to analyze particle migration through porous media at typical groundwater flow velocities. As particles accumulate within media pores, available models become less predictive because of the coupling between particle retention and permeability reduction. An examination of filtration data reveals that retention of a relatively small solid volume within media pores can reduce media permeability by orders of

magnitude. The fact that contaminants adsorbed to particles are mobile has important implications in understanding and predicting contaminant transport. The design of laboratory experiments and the collections of field samples often neglect contaminants transported by suspended colloids and particles. (Alexander-PTT)

PREDICTING MASS TRANSPORT IN DISCRETE FRACTURE NETWORKS WITH THE AID OF GEOMETRICAL FIELD DATA, Royal Inst. of Tech, Stockholm (Sweden). Dept. of Hydraulics Engineering. J. Andersson, and R. Thunvik. Water Resources Research WRERAQ, Vol. 22, No. 13, p 1941-1950, December 1986. 7 fig, 8 tab, 9 ref.

Descriptors: *Groundwater movement, *Mass transport, *Fracture networks, *Network geome-try, *Mathematical studies, *Path of pollutants, Stochastic process, Monte Carlo methods, *Perme-ability coefficient, Rock masses, Conductivity.

Mass transport in crystalline fractured rock is basi-cally controlled by the geometry of the fracture network and the properties of the individual frac-tures. Field investigations have demonstrated the need for fracture network modeling. The impor-tance of knowing the details of the fracture net-work geometry when predicting mass transport in discrete fractured media was investigated. It was assumed that some information of the fractured medium is known, such as the location and direc-tion of fractures that intersect drill cores in the medium is known, such as the location and direc-tion of fractures that intersect drill cores in the investigated region and the overall conductivity of the fracture network in this region. Individual frac-ture properties were assumed to be unknown, apart from the assumption that they follow specified stochastic distributions. A two-dimensional test problem was analyzed with the Monte Carlo tech-nique. Reality is represented by a hypothetical fracture network. On this real network, cores are drilled and the thereby intersected fractures re-corded. On the basis of the data obtained, realiza-tions of fracture networks that might represent drilled and the thereby intersected fractures recorded. On the basis of the data obtained, realizations of fracture networks that might represent
reality were generated. The data from the real
network will limit the variability of the possible
realizations of fracture networks. A problem of
mass transport was solved on the real network and
on each of the generated ones, using a particle
tracing technique. By comparing the real transport
time with the estimated transport time obtained
from the Monte Carlo runs, the advantage of increasing the measurements (for example, drilling
more holes) was analyzed. It was found that introducing more cores decreased the estimated uncertainty but that the fracture lengths, the fracture
line density, and the spatial correlation of the aperture along the fracture influenced the value of the
geometrical information. The estimated uncertainty is less in networks with long fractures combined
with a high line density and little spatial correlation of the apertures. If the fracture apertures are
adjusted so that all conditional networks have the
same hydraulic conductivity, the estimated uncertainty in transport times is reduced substantially. ne hydraulic conductivity, the estimated uncertainty in transport times is (Alexander-PTT) reduced substa (Alexander-W87-04956

SECOND-ORDER APPROACH FOR THE MODELING OF DISPERSIVE TRANSPORT IN POROUS MEDIA: 3. APPLICATION TO TWO POROUS MEDIA PROBLEMS, Massachusetts Inst. of Tech. Cambridge, Dept. of Tech.

chusetts Inst. of Tech., Cambridge. Dept. of

Massachusetts inst. of 1901, Calmings 2009.

A. F. B. Tompson, and W. G. Gray.

Water Resources Research WRERAQ, Vol. 22,

No. 13, p 1959-1971, December 1986. 16 fig. 5 tab,
20 ref. DOE Contract DE-AC02-83ER 60170.

Descriptors: *Groundwater movement, *Mathematical models, *Dispersive transport, *Porous media, *Solute transport, *Path of pollutants, *Groundwater pollution, *Aquifers, Convection, Peclet number, Tracers, Calibrations, Pore diameter, Solutes, Tracers, Calibrations, Pore diameter, Solutes, Transport

The second-order dispersion model developed by Tompson and Gray is applied to two porous media

problems: one-dimensional solute transport in a packed column and two-dimensional transport in a relatively uniform groundwater aquifer. The importance of the convective source q in the model is recognized, and estimates for its constitutive coefficients. Beta sub 1 and Beta sub 2 are found through a series of numerical experiments. For the slow-flow problems considered, the diffusive source is seems best represented through a one-term source (K sub o F) relationship only, instead of a general three-term approximation found earlier. Use of K sub o in the column test as predicted from the pipe tests of Tompson and Gray works well if the characteristic length for the Peclet number is chosen to be a typical pore diameter. This procedure did not work well in the aquifer test because of the inconsistency of applying a parameter found in a one-dimensional experiment to a two-dimensional problem Both the second-order model has a isin) approximation were satisfactory in the tracer tests considered, but the second-order model has a much sounder physical basis. The second-order model verified the results of the first-order model. (Author's abstract) W87-04958

TRANSPORT OF DISSOLVED HYDROCAR-BONS INFLUENCED BY OXYGEN-LIMITED BIODEGRADATION: 1. THEORETICAL DE-

Descriptors: *Groundwater pollution, *Solute transport, *Path of pollutants, *Fate of pollutants, *Hydrocarbons, *Biodegradation, *Contaminant plumes, *Mathematical equations, *Simulation, *Microorganisms, Advection, Adsorption, Degradation, Oaygen, Kinetics, Plumes, Solutes, Trans-

Many hydrocarbons and related organic contaminants are rapidly degradable in the presence of oxygen. Unfortunately, exchange of oxygen with subsurface contaminant plumes is often slow. Equations were developed for simulating the simultaneous growth, decay, and transport of microrganisms, as well as the transport and removal of hydrocarbon and oxygen. These equations were solved by conventional numerical techniques to study the impact of microbial kinetics, horizontal mixing, adsorption, and vertical exchange with the unsaturated zone on biodegradation. In the region near the hydrocarbon source, any available oxygen will be rapidly consumed. In the body of the near the hydrocarbon source, any available oxygen will be rapidly consumed. In the body of the hydrocarbon plume, oxygen transport will be rate limiting and the consumption of oxygen and hydrocarbon can be approximated as an instantaneous reaction. The major sources of oxygen to the plume appear to be transverse mixing, advective fluxes when adsorption is significant and vertical exchange with the unsaturated zone. In a companion paper hydrocarbon transport was simulated at a hazardous waste site where oxygen-limited biodegradation is known to occur. (See also W87-04959

TRANSPORT OF DISSOLVED HYDROCAR-BONS INFLUENCED BY OXYGEN-LIMITED BIODEGRADATION: 2. FIELD APPLICATION, North Carolina State Univ. at Raleigh. R. C. Borden, P. B. Bedient, M. D. Lee, C. H.

Ward, and J. T. Wilson.
Water Resources Research WRERAQ, Vol. 22,
No. 13, p 1983-1990, December 1986. 6 fig. 7 tab,
12 ref. EPA Assistance agreement CR-812808.

Descriptors: *Solute transport, *Mathematical models, *Model studies, *Biodegradation, *Path of pollutants, *Fate of pollutants, *Guilbrations, *Hydrocarbons, *Groundwattes, *Calibrations, *Hydrocarbons, *Groundwattes, *Calibrations, *Groundwattes, *Calibrations, *Groundwattes, *Groundwatte er pollution, Oxygen, Plu Solutes, Transport. es, Mixing, Aquifers,

An existing solute transport model was modified to allow simulation of soluble hydrocarbon transport

Group 5B-Sources Of Pollution

in groundwater influenced by oxygen-limited bio-degradation. The transport model was applied to an abandoned crosotting site where biodegrada-tion is known to occur. Oxygen exchange with the unsaturated zone and resulting biodegradation was approximated as a first-order decay in hydrocar-bon concentration. The loss of hydrocarbon due to horizontal mixing with oxygenated groundwater approximation is a mit-order decay in hydrocarbon concentration. The loss of hydrocarbon due to horizontal mixing with oxygenated groundwater and resulting biodegradation was simulated by generating oxygen and hydrocarbon distributions independently and then combining by superposition. This procedure is only applicable where absorption of hydrocarbon is negligible. The major transport parameters were obtained by calibrating the model to a chloride plume also present at the site. Simulated oxygen and hydrocarbon concentrations closely matched the observed values. Two cases are presented to illustrate the potential assimilative capacity of shallow aquifers. A companion paper presents the theoretical development. (See also W87-04959) (Alexander-PTT)

NATURAL GRADIENT EXPERIMENT ON SOLUTE TRANSPORT IN A SAND AQUIFER: 1. APPROACH AND OVERVIEW OF PLUME

MOVEMENT,
Stanford Univ., CA. Dept. of Civil Engineering.
D. M. Mackay, D. L. Freyberg, P. V. Roberts, and

J. A. Cherry. Water Resources Research WRERAQ, Vol. 22, No. 13, p 2017-2029, December 1986. 9 fig. 6 tab, 65 ref. EPA Assistance agreement CR-808851.

Descriptors: *Solute transport, *Groundwater movement, *Contaminant plumes, *Sand aquifers, *Path of pollutants, *Groundwater pollution, *Tracers, Water table, Field tests, Permeability coefficient, Porosity, Solutes, Transport, Organic compounds, Ontario, Aquifers, Landfills, Lea-chates, Halogenated hydrocarbons.

chates, Halogenated hydrocarbons.

An appreciable percentage of the groundwater used for public water supply has been found to contain detectable quantities of synthetic organic chemicals, particularly halogenated compounds containing one- or two-carbon atoms. A large-scale field experiment on natural gradient transport of solutes in groundwater was conducted at a site in Borden, Ontario. Well-defined initial conditions were achieved by the pulse injection of 12 cu m of a uniform solution containing known masses of two inorganic tracers (chloride and bromide) and five halogenated organic chemicals (bromoform, carbon tetrachloride, tetrachlorochylene, 1,2-dichlorobenzene, and hexachlorocthane). A dense, three-dimensional array of over 5000 sampling points was installed throughout the zone traversed by the solutes. Over 19,900 samples were collected over a 3-year period. The tracers followed a linear horizontal trajectory at an approximately constant velocity, both of which compare well with expectations based on water table contours and estimates of hydraulic head gradient, porosity, and hydraulic conductivity. The vertical displacement over the duration of the experiment was small. Spreading was much more pronounced in the horizontal longitudinal than in the horizontal transverse direction; vertical spreading was very small. The organic solutes were retarded in mobility, as expected. (See also W87-04964 through W87-04967) (Alexander-PTT)

NATURAL GRADIENT EXPERIMENT ON SOLUTE TRANSPORT IN A SAND AQUIFER: 2. SPATIAL MOMENTS AND THE ADVECTION AND DISPERSION OF NONREACTIVE TRACERS

ord Univ., CA. Dept. of Civil Engineering.

Water Resources Research WRERAQ, Vol. 22, No. 13, p 2031-2046, December 1986. 12 fig, 3 tab, 25 ref. EPA Assistance agreement CR-808851; NSF Grant ECE 84-51565.

Descriptors: "Solute transport, "Groundwater movement, "Sand aquifers, "Path of pollutants, "Groundwater pollution, "Tracers, "Contaminant plumes, Dispersion, Advection, Plumes, Transport, Solutes, Permeability coefficients.

The three-dimensional movement of a tracer plume containing bromide and chloride was investigated using the data base from a large-scale natural gradient field experiment on groundwater solute transport. The analysis focused on the zero-, first-, and second-order spatial moments of the concentration distribution. Moments were estimated from the point observations using quadrature approximations tailored to the density of the sampling network. The estimators appear to be robust, with acceptable sampling variability. Analysis of the first-order moment estimates indicated that the experimental tracer plumes traveled along identical trajectories. The horizontal trajectory is linear and aligned with the hydraulic gradient. The vertical trajectory is curvilinear, concave upward. The total vertical displacement was small so that the vertical component of the mean solute velocity vector negligible. The estimated mean solute velocity was identical for both tracers (0.091 m/day) and was spatially and temporally uniform for the first 647 days of travel time. After 647 days, the plume apparently encountered a relatively large-scale heterogeneity in the velocity field, leading to a distinct vertical layering, and slowing the rate of advance of the plume. The estimated horizontal components of the covariance tensor evolved over time in a manner consistent with the qualitative shape changes observed from plots of the concentration data. Plots of the components of the covariance tensor as functions of time show evidence of 'scale-dependent' dispersion. The theoretical results of Dagan calibrate well to the estimated covariance tensor as functions of time show evidence of 'scale-dependent' dispersion. The theoretical results of Dagan calibrate well to the estimated covariance tensor of the last sampling session, 1038 days after injection, are inconsistent with the earlier data and with the Dagan model. This behavior is probably attribution closely match independently measured values from the site. The estimated covariance tenso

NATURAL GRADIENT EXPERIMENT ON NATURAL GRADIENT EXPERIMENT ON SOLUTE TRANSPORT IN A SAND AQUIFER: 3. RETARDATION ESTIMATES AND MASS BALANCES FOR ORGANIC SOLUTES, Stanford Univ., CA. Dept. of Civil Engineering. P. V. Roberts, M. N. Goltz, and D. M. Mackay. Water Resources Research WRERAQ, Vol. 22, No. 13, p 2047-2058, December 1986. 9 fig. 8 tab, 35 ref. EPA Assistance agreement CR-808851.

Descriptors: "Solute transport, "Groundwater movement, "Sand aquifers, "Path of pollutants, "Groundwater pollution, "Organic compounds, Estimating, Transformation, Retardation, Sorption, Solutes, Transport, Mass balance, Aquifers, Halo-genated hydrocarbons, Quantitative analaysis.

To provide a data base suitable for documenting the behavior of organic contaminants under natural conditions and for demonstrating the significance of fundamental processes governing solute behav-ior, a long-term experiment was undertaken at Canadian Forces Base, Borden, Ontario. The study Canadian Forces Base, Borden, Ontario. The study site was in close proximity to the scene of a previous solute transport investigation at Borden that focused on chloride as a tracer. The long-term behavior of five organic solutes during transport over a period of 2 years in groundwater under natural gradient conditions was characterized quantitatively by means of moment estimates. Total mass was conserved for two of the organic compounds, carbon tetrachloride and tetrachloroethylene, while the total mass declined for three other compounds, bromoform, 1,2-dichlorobenzene, and hexachloroethane. The declines in mass for the latter three compounds are interpreted as zene, and hexachloroethane. The declines in mass for the latter three compounds are interpreted as evidence of transformation of the compounds. Retardation factors for the organic solutes, relative to chloride, ranged from 1.5 to 9.0, being generally greater for the more strongly hydrophobic compounds. The retardation is attributed to sorption. The apparent retardation factor increased markedly for all compounds over the duration of the experiment, by as much as 150%. Results from temporal and spatial sampling were in good agreement when compared at the same scale of time and

distance. (See also W87-04963, W87-04964, W87-04966, W87-04967) (Alexander-PTT)

NATURAL GRADIENT EXPERIMENT ON SOLUTE TRANSPORT IN A SAND AQUIFER: 4. SORPTION OF ORGANIC SOLUTES AND ITS INFLUENCE ON MOBILITY, Stanford Univ., CA. Dept. of Civil Engineering. G. P. Curtis, P. V. Roberts, and M. Reinhard. Water Resources Research WRERAQ, Vol. 22, No. 13, p. 2039-2067, December 1986. 4 fig. 6 tab, 41 ref. EPA Assistance agreement CR-808851.

Descriptors: *Solute transport, *Sand aquifers, *Groundwater pollution, *Groundwater movement, *Path of pollutants, *Organic compounds, *Sorption, *Mathematical models, Isotherms, Prediction, Distribution, Retardation, Mobility, lutes, Transport, Halogenated hydrocarbons.

Laboratory investigations were conducted to determine whether the observed field retardation of bromoform, carbon tetrachloride, tetrachloroethylene, 1,2-dichlorobenzene, and hexachloroethane at the Borden, Ontario, field site could be explained by the linear, reversible, equilibrium sorption model. The five halogenated organic solutes, which have octanol-water partition coefficients ranging from 200 to 4000, were the same as those used in the field study. The sorbent, a medium sand containing 0.02% organic carbon, was excavated 11.5 m from the experimental well field at the Borden site. Sorption isotherms were linear in the aqueous concentration range from 1 to 50 microgram/L and could be described by a single distribution coefficient K sub d. The experimentally determined K sub d exceed those predicted by the hydrophobic sorption model that accounts only for partitioning into organic matter, by factors ranging rom 1.7 for haveableonethes to 10 for started learned. partitioning into organic matter, by factors ranging from 1.7 for hexachloroethane to 10 for tetrachlornom 1.7 for nexactioroethane to 10 for tetrachlor-oethylene. Retardation factors inferred from the laboratory-determined distribution coefficients fell within the range estimated from spatial sampling data in the field experiment. (See also W87-04963 through W87-04965, W87-04967) (Alexander-PTT) W87-04966

NATURAL GRADIENT EXPERIMENT ON SOLUTE TRANSPORT IN A SAND AQUIFER: SPATIAL VARIABILITY OF HYDRAULIC CONDUCTIVITY AND ITS ROLE IN THE DIS PERSION PROCESS.

Waterloo Univ. (Ontario). Dept. of Earth Sciences. E. A. Sudicky.

Water Resources Research WRERAQ, Vol. 22, No. 13, p 2069-2082, December 1986. 11 fig, 24 ref. EPA Assistance agreement CR-808851.

Descriptors: *Groundwater movement, *Solute transport, *Sand aquifers, *Path of pollutants *Permeability coefficient, *Dispersion, *Spatial variability, *Tracers, *Model studies, Estimating, Prediction, Transport, Solutes, Aquifers, Groundwater pollution.

water pollution.

The spatial variability of hydraulic conductivity at the site of a long-term tracer test performed in the Borden (Ontario) aquifer was examined in detail by conducting permeability measurements on a series of cores taken along two cross sections, one along and the other transverse to the mean flow direction. Along the two cross sections, a regular-spaced grid of hydraulic conductivity data with 0.05 m vertical and 1.0 m horizontal spatial discretization revealed that the aquifer is comprised of numerous thin, discontinuous lenses of contrasting hydraulic conductivity. Estimation of the three-dimensional covariance structure of the aquifer from the log-transformed data indicates that an exponential covariance model with a variance equal to 0.29, an isotropic horizontal correlation length equal to about 2.8 m, and a vertical correlation length equal to 0.12 m is representative. A value for the longitudinal macrodispersivity calculated from these statistical parameters using three-dimensional stochastic transport theory developed by Gelhar and Axness is about 0.6 m. For the vertically averaged case, the two-dimensional theory developed by Dagan yields a longitudinal dispersivity equal to 0.45 m. Use of the estimated

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statistical parameters describing the ln (K) variability in Dagan's transient equations closely predicted the observed longitudinal and horizontal transverse spread of the tracer with time. Weak vertical and horizontal dispersion that is controlled essentially but local each dispersion was obtained from the horizontal dispersion that is controlled essentially by local-scale dispersion was obtained from the analysis. Because the dispersion predicted independently from the statistical description of the Borden aquifer is consistent with the spread of the injected tracer, it is felt that the theory holds promise for providing meaningful estimates of effective transport parameters in other complex-structured aquifers. (See also W87-04963 through W87-04966) (Author's abstract)

NATURAL AND ANTHROPOGENIC CAUSES OF LAKE ACIDIFICATION IN NOVA SCOTIA, Minnesota Univ., Minnespolis. Dept. of Ecology and Behavioral Biology. E. Gorham, J. K. Underwood, F. B. Martin, and J. G. Ooden.

G. Ogden.

G. Ogden.Nature NATUAS, Vol. 324, No. 6096, p 451-453,December 4, 1986. 3 fig, 33 ref.

Descriptors: *Lakes, *Water pollution sources, *Water analysis, *Acid rain, *Acidic water, *Acidification, *Anthropogenic acid deposition, Soil acidification, Acid soils, Nova Scotia, Organic acids, Acid deposition, Ion exchange, Hydrogen ion concentration, Air pollution.

Controversy has arisen over the recent acidification of lakes, ascribed by many to anthropogenic
acid deposition from the atmosphere, and by some
to natural processes of soil acidification enhanced
by the regrowth of forests after cutting and burning. It was shown, by analyzing the chemistry of
Nova Scotian lakes and ponds on base-poor terrains, that both anthropogenic and natural acidification can be important. The correlations and regressions were calculated between hydrogen ion
concentrations and each of four predictors dissolved organic carbon (a surrogate for complex
colored organic acids, often of high molecular
weight), non-marine sulfate (a surrogate for acid
deposition), non-marine calcium ions (the major
basic cation from soil weathering and ion exchange), and the sum of the other non-marine base
cations (sodium, magnesium and potassium). The
results indicate that acidity in these waters is affected both by organic acids from peatland catchments and by cellid decestion force here acceptfected both by organic acids from peatland catch-ments and by acidic deposition from long-range and local sources. (Author's abstract)

EXAMINATION OF A SUBGRID-SCALE PARAMETERIZATION FOR THE TRANSPORT OF POLLUTANTS IN A NONPRECIPITATING CUMULUS CLOUD ENSEMBLE, lowa Univ., lowa City. Dept. of Chemical and Materials Engineering.

M.-S. Hong, and G. R. Carmichael.
Atmospheric Environment ATENBP, Vol. 20, No. 11, p 2205-2217, November 1986. 9 fig. 1 tab, 12 ref.

Descriptors: *Transport, *Clouds, *Path of pollutants, *Model studies, *Eulerian models, *Mathematical models, *Air pollution, Mathematical equations, Entrainment, Detrainment, Evaporation, Subsidence, Eddy diffusion, Simulation, Pollutants, Mathematical studies.

The mass flux based subgrid-scale parameterization technique of Gidel is re-examined for use in Eulerian long-range transport models. Specifically, the parameterization scheme is incorporated into the STEM-II Eulerian transport/transformation/removal model and the model is used to investigate pollutant transport in a nonprecipitating cumulus moval model and the model is used to investigate pollutant transport in a nonprecipitating cumulus cloud ensemble. The effects of entrainment, detrainment, evaporation and the transport by subsidience, updrafts and turbulent diffusion are included in the analysis. Presented simulation results indicate that the parameterization is able to treat the rapid vertical transport by cloud updrafts, enables the calculation of reaction rates based on subgrid-scale concentrations, and is readily adopted by Eulerian models. (Author's abstract) W87-04992.

REMOVAL OF SULPHUR DIOXIDE IN A TWO-DIMENSIONAL RAIN SYSTEM BASED ON A SCALE ANALYSIS OF THE CONSERVATION EQUATIONS, Central Electricity Generating Board, Leatherhead (England). Central Electricity Research

Laos. B. E. A. Fisher, and P. A. Clark. Atmospheric Environment ATENBP, Vol. 20, No. 11, p 2219-2229, November 1986. 7 fig, 1 tab, 9 ref.

Descriptors: *Path of pollutants, *Rain, *Sulfur compounds, *Conservation equations, *Sulfates, *Mathematical models, *Model studies, Cloud liquid water, Oxidation, Ozone, Weather, Velocity, Fall velocity, Advection, Mathematical equations, Mathematical studies, Air pollution, Transport.

n systems show a wide variation in structure in both time and space, it is virtually impossi-ble to model in detail the behavior of sulfur passing through a rain system. Instead, an attempt has been made to determine the scales of the major process-es going on in a frontal rain system based on the conservation equations for cloudwater, rainwater, SO2 in air, sulfate in cloud and sulfate in rainwater. When this procedure is followed it is found that cloud and sulfate in rainwater. When this procedure is followed it is found that cloud and rainwater amounts are determined largely as a dynamic balance between cloudwater condensation and accretion of cloud drops by rain.
The removal of SO2 in rain is mainly determined
by the oxidation of SO2 in cloud, enhanced by
oxidation in rain. In the case when oxidation of
SO2 by O3 is the primary oxidation pathway a
simple formula is derived for the fractional removal efficiency, which shows which parameters are of
greatest importance and has potential use in the
current generation of long-range transport models.
This formula shows that the removal efficiency is a
strongly non-linear function of sulfur dioxide concentration. At regional average SO2 concentrations removal is efficient, but decreases rapidly at
higher SO2 concentrations. (Author's abstract)
W87-04993

KINETICS OF FORMALDEHYDE-S(IV) ADDUCT FORMATION IN SLIGHTLY ACIDIC

SOLUTION, California Inst. of Tech., Pasadena. W.M. Keck Cantorina 1881. of 1eCh., Pasaucina. W.M. Reck Lab. of Environmental Engineering Science. T. M. Olson, and M. R. Hoffmann. Atmospheric Environment ATENBP, Vol. 20, No. 11, p 2277-2278, November 1986. 1 fig. 5 ref.

Descriptors: *Pollutant identification, *Acid rain, *Sulfur compounds, *Kinetics, *Path of pollutants, *Chemical reactions, *Cloud liquid water, *Fog. Clouds, Dehydration, Acids, Hydroxymethanesul-fonic acid, Pollutants, Solutes, Adducts.

Calculations are presented which demonstrate that the kinetics of dehydration of methylene glycol (hydrated form of formaldehyde) must be considered in determining the rate of hydroxymethane-sulfonic acid formation in weakly acidic or neutral solution. The findings were applied to the chemistry of acidic fog and cloud water. (Wood-PTT) W87-04994

TBT: AN ENVIRONMENTAL DILEMMA Scripps Institution of Oceanography, La Jolla, CA. For primary bibliographic entry see Field 5C. W87-04996

MODELLING THE FATE OF MIREX AND LINDANE IN LAKE ONTARIO, OFF THE NI-AGARA RIVER MOUTH, National Water Research Inst., Burlington (Ontar-io). Environmental Simulation Section.

Ecological Modelling ECMODT, Vol. 33, No. 1, p 13-33, September 1986. 4 fig, 6 tab, 29 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Water pollution effects, *Model studies, *Lakes, *Rivers, *Mires, *Lindane, *TOXFATE model, Lake Ontario, Niagara River, Mathematical models, Contamination, Degradation, Volatility, Simulation, Simulation analysis, Fish populations, Fish, Plankton, Sediments, Pollutants, Transport, Plumes, Prediction.

A seasonally averaged (June-November) fate model (TOXFATE) of organic contaminants was used to assess the relative importance of transport, degradation and volatilization processes in the Ni-agara River and in Lake Ontario near the river mouth The model residies concentration: degradation and volatilization processes in the Niagara River and in Lake Ontario near the river mouth. The model predicts concentrations in several compartments, including suspended sediments, water, plankton, and fish. Two contaminants were modelled, Mirex and alpha-bexachlorocyclohexane (Lindane). Simulations show that the largest amount of contaminants is usually in the water fraction. About 70% of Mirex is in the water at the mouth of the Niagara River, compared with 99% for Lindane. For these two contaminants, the processes of degradation and volatilization are two to three orders of magnitude slower than the rate of transport through the river and the plume. In the water, the most important process is a change of phase, from dissolved to the adsorbed state. This change of state is mostly relevant for strongly hydrophobic compounds like Mirex, and less so for Lindane. Simulations were performed for a 40-day period during which fish concentrations did not reach equilibrium with Mirex, but they did with Lindane. Spatial distributions of these contaminants were also predicted and compared with available data. (Author's abstract)

PERSONAL EXPOSURES, INDOOR AND OUTDOOR AIR CONCENTRATIONS, AND EXHALED BREATH CONCENTRATIONS OF SE-HALED BREATH CONCENTRATIONS OF SE-LECTED VOLATILE ORGANIC COMPOUNDS MEASURED FOR 600 RESIDENTS OF NEW JERSEY, NORTH DAKOTA, NORTH CAROLI-NA AND CALIFORNIA, Harvard Univ., Cambridge, MA. Energy and En-vironmental Policy Center. L. A. Wallace. Toxicological and Environmental Chemistry TXECBP, Vol. 12, No. 3/4, p 215-236, 1986. 4 tab, 14 ref.

Descriptors: *Population exposure, *Chlorinated hydrocarbons, *Organic compounds, *TEAM Study, *Drinking water, *Fate of pollutants, *Pollutant identification, *Air samples, Toxicity, Monitoring, Occupational exposure, Chromatography, Spectral analysis, Respiration, Organic solvents.

Spectral analysis, Respiration, Organic solvents. The TEAM (Total Exposure Assessment Methodology) Study was planned in 1979 and completed in 1985. The goals were: (1) to develop methods to measure individual total exposure (exposures through air, food, and water) and resulting body burden of toxic and carcinogenic chemicals, and (2) to apply these methods within a probability-based sampling framework to estimate the exposures and body burdens of urban populations in several U. S. cities. EPA's TEAM Study has measured exposures to 20 volatile organic compounds in personal air, outdoor air, drinking water, and breath of 600 residents of New Jersey, North Carolina, North Dakota, and California. All participants were selected by a probability sampling scheme to represent a total of 700,000 inhabitants of seven cities. About 7500 air, breath, and drinking water samples were collected, of which 2000 were quality controls. Chloroform and possibly bromodich-loromethane were important contributors to total exposure from drinking water was 67 microgm/L. In drinking water in California, bromoform appeared in 70-90% of the samples compared to almost none of the New Jersey samples. The common solvents, trichloroethylene, tetrachloroethylene, eterachlor-oethylene, and 1,1,1-trichloroethane, were present in samples from both California and New Jersey. For all chemical except the trihalomethanes, the air route provided >99% of the exposure to the brominated trihalomethanes and more than half of most personal exposures to chloroform. (Peters-PTT) W87-05033

SEASONAL DYNAMICS OF PHOSPHORUS PARTITIONING AND EXPORT IN TWO STREAMS IN ALBERTA, CANADA, erta Univ., Edmonton. Dept. of Zoology. N. Munn, and E. Prepas. Canadian Journal of Fisheries and Aquatic Sci-

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ences CJFSDX, Vol. 43, No. 12, p 2464-2471, December 1986. 5 fig, 3 tab, 17 ref.

Descriptors: "Path of pollutants, "Seasonal variation, "Phosphorus, "Mathematical models, "Nutrients, "Cycling nutrients, Transport, Streams, Watersheds, Storms, Glacial till, Bedrock, Climates, Trees, Alberta, Export.

In 1983, phosphorus (P) export was quantified for two streams (Two Creek and Sakwatamau River) in Alberta, Canada. The influence of changes in two streams (Two Creek and Sakwatamau River) in Alberta, Canada. The influence of changes in discharge on P concentration and partitioning was examined on an annual and seasonal basis and these data were used to develop empirical models to predict P concentrations. Phosphorus export peaked during summer storms; 68% of annual total P loading was transported during 12 d in early summer. Phosphorus increases were larger during storms in early summer than during storms in late summer. Annual total P exports were 7.5 and 13.0 mg/sq m (watershed area) for the two streams, primarily in the fine particulate fraction. The empirical models presented are the first based on detailed data from watersheds with the following characteristics: (1) trees predominantly coniferous, (2) deep glacial till overlying sedimentary bedrock, and (3) climatic regime where most P is exported during summer storms. These results underscore the need for intensive sampling regimes in streams in a variety of regions (especially at high discharge) so factors controlling P levels can be better understood. (Author's abstract) W87-05052

GASEOUS BEHAVIOR OF TCE OVERLYING A

CONTAMINATED AQUIFER,
D. L. Marrin, and G. M. Thompson.
Ground Water GRWAAP, Vol. 25, No. 1, p 21-27,
January-February 1987. 3 fig. 4 tab, 8 ref. EPA
Assistance agreement CR-811018.

Descriptors: *Trichloroethylene, *Pollutant identification, *Path of pollutants, *Groundwater pollution, *Contaminant plumes, *Monitoring wells, *Soil gas, Water table, Solute transport, Transport, Diffusion, Aquifers, Porosity, Plumes, Organic compounds, Solvents, Chlorinated hydrocarbons.

compounds, Solvents, Chlorinated hydrocarbons. The concept of monitoring vadose zone air or soil gas to detect groundwater contaminants has been suggested by several authors. Success in using shallow soil gas analysis as a remote geochemical technique to detect volatile organic compounds (VOCs) in groundwater has been reported. The success of soil gas analyses in detecting groundwater contaminants depends on volatilization of VOCs at the water table and diffusion of these compounds through soil gas in a predominantly vertical direction. Shallow soil gas (< 2 meters deep) was collected and analyzed for trichloroethylene (TCE) to determine the relationship with ground-water contamination directly below. The gaseous TCE plume was mapped with 46 probes and spanned three orders of magnitude in concentrations in water from five monitoring wells around the study site ranged from 4 to 2800 pps and had a correlation coefficient (c) of 0.90 with TCE concentrations in shallow soil gas. Vertical and had a correlation coefficient (r) of 0.90 with TCE concentrations in shallow soil gas. Vertical borings were completed to the water table at four locations in order to obtain profiles of soil gas contamination, air porosity, and water saturation. Gaseous diffusion and air/water partitioning are probably the dominant mechanisms involved in transporting TCE from the ground water to the shallow soil gas. (Alexander-PTT) W87-05064

RADON AND RADIUM EMANATIONS FROM FRACTURED CRYSTALLINE ROCKS - A CON-CEPTUAL HYDROGEOLOGICAL MODEL,

H. E. LeGrand. Ground Water GRWAAP, Vol. 25, No. 1, p 59-69, January-February 1987. 6 fig, 25 ref.

Descriptors: *Mathematical models, *Hydrogeological models, *Geologic fractures, *Crystalline rocks, *Air pollution sources, *Radon, *Radium, *Path of pollutants, Accretion, Mobility, Infiltration, Soil horizons, Bedrock, Topography, Well water, Groundwater, Diffusion, Prediction.

Subsurface air is a refuge for radon gas escaping from rock and soil surfaces, as well as from subsurface water. The crystalline rocks of eastern United States contain granites and associated rocks that States contain granites and associated rocks that have moderate to low amounts of uranium source man grantes and associated rocks that have moderate to low amounts of uranium source material; the amounts are sufficient for radon to emanate significantly from both the soil-saprolite zone and the part of the underlying fractured rock above the water table. The pressure increases in the air systems chiefly as infiltrated water moves downward and as the water table rises. The radon-laden air moves toward two types of low-pressure chambers. One type of chamber is a house on sloping topography niched into the soil-saprolite zone and perhaps into bedrock fractures. The other type is the unwatered fracture zone of a pumping cone of depression where overlying clays are less permeable. These two types of low-pressure chambers have characteristics of vacuum cleaners, suching in radon-laden air. Conditions leading to high indoor radon concentrations are: (1) granites and associated rocks with normal or above normal amounts of uranium, (2) normal inter connecting fractures. associated rocks with normal or above normal amounts of uranium, (2) normal inter connecting fracture pattern, (3) a thin mantle of relatively impermeable clay soil, (4) repeated cycles of recharge and of fluctuating water table in the fracture zone or in the overlying regolith, (5) indentation of buildings into soil and rock materials, and (6) building construction allowing relatively easy inflow of air from the subsoil and rock. Promoting the continual accretion of radon and radium in well water is the alternating action of air and water in the tortuous fractures in the cone of pumping depression. Radon accretes in well water more readily than does radium, chiefly because it is able to diffuse out of the pores and small fractures to then become mixed with the churned well water; then become mixed with the churned well water; radium tends to be absorbed on the rock materials, but the resurging ground water may desorb or dislodge radium and bring it into the well in some cascoage ractum and oring it into the well in some cases. The hydrogeological model is compatible with data and nonhydrogeological interpretations by other workers. The framework provides a partial basis for a future predictive model that may identify potential problem sites of airborne radon indoors, and both radon and radium in well water. (Author's abstract) (Author's abstract) W87-05068

MODELING OF TCE CONTAMINATION AND RECOVERY IN A SHALLOW SAND AQUIFER, McClelland Engineers, Inc., Houston, TX.
K. M. Freeberg, P. B. Bedient, and J. A. Connor.
Ground Water GRWAAP, Vol. 25, No. 1, p 70-80,
January-February 1987. 7 fig. 3 tab, 18 ref. EPA
Assistance agreement CR-812808.

Descriptors: *Mathematical models, *Trichlor-oethylene, *Path of pollutants, *Sand aquifers, *Solute transport, *Groundwater pollution, *Com-puter programs, *Monitoring wells, Prediction, Organic compounds, Solvents, Transport, Moni-toring, Wells, Groundwater, Chlorinated hydro-

Computer simulation of contaminant movement in the subsurface provides a useful tool in groundwater investigations. When applied to a sufficiently detailed hydrologic data base, numerical solute transport models are capable of simulating the extent and concentration of groundwater contamination and predicting the movement of contamina nation and predicting the movement of contami-nant plumes. The U.S. Geological Survey (USGS) Solute Transport Model is a widely used, well-documented computer code which simulates condocumented computer code which simulates contaminant transport in groundwater using a finitedifference grid and the method of characteristics.
The model was applied to an industrial site where
trichloroethylene (TCE) and other industrial solvents had contaminated a shallow sand aquifer. At
the study site, the geology was well-characterized
and the migration of the contaminant plume was
monitored by a network of 15 wells. Although the
rate of release of the industrial solvents to the
aquifer was unknown, the model gave a good
prediction of the movement of the plume when the
release of contaminants was modeled as a point
source injection. The model was also successful in
simulating the behavior of the plume under the source injection. The model was also successful in simulating the behavior of the plume under the influence of a recovery system. During simulation of a four-well withdrawal system, model predic-tions of TCE concentrations and hydraulic head in

the aquifer matched actual data collected at two points in time after start-up of the recovery system. The model predicted that the same configuration of withdrawal wells would reduce concentrations of TCE in the ground water from approximately 1000 microgram(ug)/L to 6 ug/L after two years of pumping. (Alexander-PTT) W87-05069

INNOVATIVE MEANS OF DEALING WITH POTENTIAL SOURCES OF GROUND WATER CONTAMINATION. National Water Well Association, Worthington, OH.

For primary bibliographic entry see Field 2F. W87-05071

MANAGEMENT OF GASOLINE LEAKS - A
POSITIVE OUTLOOK,
Los Angeles City Dept. of Water and Power, CA.
For primary bibliographic entry see Field 5G.
W87-05074

EFFECTS OF URANIUM MILL TAILINGS ON GROUND WATER QUALITY: A HISTORICAL

PERSPECTIVE,
Nuclear Regulatory Commission, Washington,
DC. Div. of Waste Management.
For primary bibliographic entry see Field 5C.
W87-05081

RAPID ASSESSMENT METHODOLOGY FOR LEACHING OF AGRICULTURAL CHEMICALS,

CALS,
Anderson-Nichols and Co., Inc., Palo Alto, CA.
J. D. Dean, P. P. Jowise, A. S. Donigian Jr, R. F.
Carsel, and L. A. Mulkey.
IN: Innovative Means of Dealing with Potential
Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water
Quality Symposium, September 26-28, 1984, Las
Vegas, Nevada. National Water Well Association,
500 W. Wilson Bridge Road, Worthington, Ohio,
1984. p 246-272, 10 fig, 2 tab, 16 ref. EPA Contract
No. 68-03-3116.

Descriptors: *Pesticides, *Leaching, *Agricultural chemicals, *Path of pollutants, Corn, Soybeans, Wheat, Cotton, Infiltration capacity, Organic carbon, Degradation, Runoff, Time series analysis.

carbon, Degradation, Runoff, Time series analysis.

A screening methodology was devised to detect large areas (on a national scale) in which certain combinations of pesticide/soil and climatic parameters might combine to favor contamination of groundwater due to pesticide leaching. Four major crops were investigated: corn, soybeans, wheat and cotton. Factors important to pesticide leaching such as precipitation, soil infiltration capacity, soil organic carbon, etc. were used to delineate regions thought to differ in their pesticide transport potential. In each of these areas, the Pesticide Root Zone Model was used to simulate a 25 year time series of pesticide leachings past the crop rooting depth. These time series were expressed as annual values of percent of applied chemical leached and analyzed by constructing frequency histograms. These histograms were organized by region and indexed using matrices. By determining three key parameters - retardation factor, pesticide degradation rate and runoff curve number, the user can determine if significant quantities of pesticide will leach under a particular pesticide/site/crop/manleach under a particular pesticide/site/crop/man-agement scenario. (See also W87-05071) (Lantz-PTT W87-05085

ABANDONED WELLS - HOW TO FIND THEM, National Water Well Association, Worthington,

L. Aller.

IN: Innovative Means of Dealing with Potential Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio,

Sources Of Pollution-Group 5B

1984. p 288-305, 7 fig, 9 ref.

Descriptors: *Abandoned wells, *Path of pollutants, *Water pollution prevention, *Groundwater pollution, Water quality control, Geophysics, Electrical studies, Resistivity, Electromagnetic waves, Conductivity, Remote s

Improperly plugged or unplugged abandoned wells which penetrate an injection formation may provide a conduit for migration of injected fluids into fresh water formations. A search for abandoned wells may have three different objectives: into fresh water formations. A search for abandoned wells may have three different objectives:

(1) to provide an overview of the presence or absence of abandoned wells within an area, (2) to determine the status of a particular well and establish the potential impact of that well, and (3) to actually field locate the abandoned well. The scope of a search may encompass all or any combination of these objectives before the search is completed. To date, few methods have been successfully used to search for abandoned wells. Most searches have employed a combination of record searching, talking over the area with a metal detector or magnetometer. While few methods have actually been used, a variety of other technologies, although not specifically developed for this purpose may be useful in searching for abandoned wells. Geophysical methods such as electrical resistivity, electromagnetic conductivity and ground penetrating radar all may have various applications in searching for abandoned wells. Remote sensing techniques, including black and white aerial photographs, color photographs, color infrared and thermal infrared may be combined with other methods ing for abandoned wells, kemote sensing tech-niques, including black and white aerial photo-graphs, color photographs, color infrared and ther-mal infrared may be combined with other methods to provide a different dimension to the search. Other more indirect methods such as water-level measurements or actual injection may also be applicable in certain situations. The best combination pircape in certain stuations. The best communities of methods depends on the objectives of the search, the condition and surface expression of the abandoned well and the resources available to conduct the search. (See also W87-05071) (Author's abstract)

SUMMARY AND COMPARISONS OF THREE TECHNOLOGIES FOR LOCATING ABAN-DONED WELLS IN CENTRAL OKLAHOMA Environmental Photographic Interpreta Center, Warrenton, VA. J. J. van Ee, L. Aller, F. Frischknecht, and D. Fairchild.

Fairchild.

IN: Innovative Means of Dealing with Potential
Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water
Quality Symposium, September 26-28, 1984, Les
Vegas, Nevada. National Water Well Association,
500 W. Wilson Bridge Road, Worthington, Ohio,
1984. p 306-329, 16 fig, 7 tab, 5 ref.

Descriptors: *Abandoned wells, *Oklahoma, *Technology, *Water pollution sources, Oil wells, Natural gas, Aerial photography, Cost analysis, Aeromagnetics.

Aeromagnetics.

Three methods were used to locate abandoned oil and gas wells in Oklahoma with varying degrees of cost and success. As each method was used in succession to survey the study areas, the level of confidence that all abandoned wells had been located increased, but each method also raised the total cost of the investigation. The records search provided information on well construction which other two techniques cannot supply. Therefore, it is likely that a records search will always be required to assess the pollution potential from abandoned wells. Unfortunately, the information contained in the records on both well location and construction may not be complete or accurate. Additional location techniques are desirable to supplement the data. Historical aerial photographs are particularly valuable for those periods when records are not complete or accurate. The cost of an historical aerial photographic search is comparable to the estimated \$50/well cost of locating abandoned wells from a records search and the accuracy in locating a well is apt to be better. The aeromagnetic method, like the photographic method, can be readily used to locate abandoned wells for many areas where there has been no

surface evidence of the well. Large areas can be surveyed rapidly from the air without need for access to the property. While the method allows a well casing to be located to within 3 to 6 feet with the aid of a ground-magnetometer, the method is costly. An aeromagnetic survey requires more sophisticated equipment and technical expertise than the other two methods. However, more wells were detected by the aeromagnetic surveys than by the initial photointerpretation. For any survey, the method(s) selected will depend on the available resources and the potential threat posed by unknown locations of abandoned wells in an area. (See also W87-0508)

ABANDONED WATER WELLS IN SOUTH-EASTERN MINNESOTA, Minnesota Dept. of Natural Resources, St. Paul.

Div. of Waters

P. K. Blomquist.

IN: Innovative Means of Dealing with Potential

Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water ceedings of the Seventh National Ground water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 330-342, 4 fig. 2 tab, 23 ref.

wells, *Minneson Froundwater pollu-restruction Descriptors: *Abandoned wells, *Minne water pollution sources, *Groundwater puton, Multiaquifer systems, Well construction, Multiaquifer systems, Well construction water quality, Well drilling.

Previous studies have shown that abandoned wells and multiaquifer wells are a problem of great magnitude in southeastern Minnesota. A total of 113 abandoned wells were located on Department of Natural Resources land; geophysical findings in 15 of them indicate that 67% of those wells had collapsed since being drilled and 47% were of multiaquifer construction. Since 70% of the located wells had thinwall casing, which usually only extends through unconsolidated material, they are improperly constructed, unstable and possibly utilized more than one aquifer. Over 11,000 abandoned wells exist in the southeast corner of Minnesota. Application of established percentages indicate that an estimated 5,200 abandoned water wells are multiaquifer, 7,400 of which are unstable and may collapse if they have not already done so. Groundwater quality in southeastern Minnesota is of vital concern to residents of this agricultural region. For the protection of this resource, the abandoned water wells that are multiaquifer in construction should be properly sealed. Those multiaquifer wells which have already collapsed may have to be redrilled for placement of a water-tight will not be a way if ignored. In fact, it is growing as the population of the region grows, more wells are being drilled, more septic systems are being placed, and more agricultural chemicals are being used. (See also W87-05071) (Lantz-PTT)

CONTRARY WASTE SITE CHARACTERISTICS – GOOD IS BAD, BAD IS GOOD, For primary bibliographic entry see Field 5E. W87-05091

TRANSPORT OF ORGANIC CONTAMINANTS IN GROUND WATER, New Mexico Inst. of Mining and Technology,

New Socorro. P Khaleel.

Descriptors: "Path of pollutants, "Groundwater movement, "Groundwater pollution, "Organic compounds, Mathematical models, Saturated flow, Unsaturated flow, Mathematical equations, Mathe-matical analysis, Flow velocity, Porous media, Leakage, Oil spills.

A numerical model has been developed to describe the transport of organic contaminants in a two-dimensional, integrated saturated-unsaturated porous medium. The transport problem requires the solution of (1) equations describing simultane-ous flow of two immiscible fluids, and (2) the ous flow of two immiscible fluids, and (2) the equations describing the convective-dispersive transport of the dissolved contaminants. A two-dimensional, two-phase fluid flow model is used to solve the flow equations. At each time step, the two-phase flow equations are solved using an implicit scheme to solve for wetting or non-wetting phase fluid saturations. Estimates of wetting phase and non-wetting phase fluid saturations are then used as imputs to the convective-dispersion equations, which are related to the fluid flow equations by the see-pase velocity. The method of charactertions, which are related to the fluid flow equations by the seepage velocity. The method of characteristics, as developed in the petroleum industry, is used to solve convective-dispersive equations in a two-dimensional, saturated-unsaturated porous medium. The accuracy of the numerical simulator, when tested by comparing with available analytical solutions, other numerical solutions and experimental data, provided excellent agreement. The proposed simulator has potentially wide applications in studying the transport of gasoline hydrocarbons resulting from leakage or spills. (See also W87-05071) (Author's abstract)

UNCERTAINTY IN GROUND WATER TRANS-PORT MODELING,

PORT MODELING, Oklahoma State Univ., Stillwater. W. A. Pettyjohn, J. Wagner, and T. A. Prickett. IN: Innovative Means of Dealing with Potential Sources of Ground Water Contamination. Pro-ceedings of the Seventh National Ground Water ceedings of the seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 388-410, 9 fig. 1 tab, 44 ref. EPA Coopera-tive Agreement No. CR-811116.

Descriptors: *Path of pollutants, *Solute transport, *Groundwater movement, *Model studies, Computer models, Mathematical models, Statistical analysis, Monte Carlo Method, Chromium, Mathematical analysis, Long Island, New York.

A variety of computer codes are available to model the transport of chemical constituents in groundwater. The major drawback of all of the codes, however, is the uncertainty of the input parameters. The approach presented here is to utilize a two dimensional solute transport model to which has been added a Monte Carlo routine. which has been added a monte Carlo rounne.

Monte Carlo simulations can provide a useful means of incorporating the uncertainty of input parameters into deterministic solute transport models. This stochastic model provides a number of statistical outputs that can be interpreted in more familiar terms, such as riak analysis. The code has been designed for use on microcomputers; it is written in FORTRAN and is menu driven. As an written in FURIN and is meat driven. As an example, the well known case of chromium contamination on Long Island is considered. It is assumed that the saturated thickness ranges from 105 to 115 feet, effective porosity from 0.34 to 0.36, interstitial velocity from 1.45 to 1.55 feet/day, longitudinal and transverse dispensity from 69. 0.36, interstitial velocity from 1.45 to 1.55 feet/day, longitudinal and transverse dispersivity from 69 to 71 feet and 13 to 15 feet, respectively, retardation of 1, and source loading from 51 to 53 lb/day. An observation point 4200 feet directly downgradient from the lagoons, which have been operating for 2800 days is also is also assumed. After 1024 iterations, output indicates that the concentration of chromium at the observation point could range between 7.2 and 9.7 mg/L, but it has the most probable concentration of 8.4 mg/L. Output also indicates that there is a 90% certainty (risk) that the concentration will be equal to or less than 9.0 mg/L and a 10% certainty that it will be equal to or less than 7.8 mg/L. Presently the model calculates the concentration only at one specific site for lates the concentration only at one specific site for each simulation. (See also W87-05071) (Lantzecific site for PTT) W87-05093

EVALUATION OF THE PERFORMANCE OF ZONE OF SATURATION LANDFILLS IN WIS-

Group 5B-Sources Of Pollution

Wisconsin Dept. of Natural Resources, Madison. Bureau of Solid Waste Management.
M. E. Gordon, and P. M. Huebner.
IN: Innovative Means of Dealing with Potential Sources of Ground Water Contamination. Proceedings of the Savards Matient Contamination. Sources of Ground water Contamination: Fro-ceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegza, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 411-440, 11 fig, 6 tab, 15 ref, append.

Descriptors: *Performance evaluation, *Landfills, *Waste disposal, *Wisconsin, *Saturation zone, *Groundwater pollution, Clays, Leachates, Rainfall, Hydraulic gradients, Water table, Groundwater

A typical 'zone-of-saturation' landfill in Wisconsin is developed by excavating into a saturated clay soil environment. The excavation functions as a A typical zone-of-asturation into a saturated clay soil environment. The excavation functions as a discharge site by creating a depression in the water table, but does not fill with groundwater because evaporation exceeds the rate of seepage from low-permeability clay deposits. Once the base and sidewalls of the excavation are covered with refuse groundwater, inflow and percolation from rainfall must be removed by the leachate collection system. The potential for leachate migration away from this type of landfill is minimized as long as inward hydraulic gradients are maintained at the base and perimeter of the facility. Recent investigations have revealed that many zone-of-saturation aircs are not situated in a homogeneous' clay environment. The unexpected buildup of leachate within several of the 12 landfills approved in Wisconsin using this design concept has led to the development of outward gradients. A detailed performance evaluation of three of these sites (Omega Fillis), North Outagamie County, and Winnebago County) where groundwater contamination is occurring. Supplemented by data and observations from several of the sites, forms the basis for recommendations for the investigation, design and operation of a zone-of-saturation landfill. Although there is insufficient data to evaluate their effectiveness fully, it is concluded that implementation of these recommendations will provide for an acceptable level of groundwater protection at landfills sing this design concept. (See also W87-05071) (Author's abstract)

MONITORING OF GROUND WATER CON-TAMINATION FROM WASTE DISPOSAL SITES IN ALBERTA, CANADA, Alberta Environment, Edmonton. W. J. Ceroici.

In: Innovative Means of Dealing with Potential Sources of Ground Water Contamination. Pro-ceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984, p 441-452, 4 fig. 1 tab, 4 ref.

Deacriptors: *Groundwater pollution, *Waste disposal aites, *Waste disposal, *Monitoring, *Alberta, Landfills, Municipal wastes, Piezometry, Water table, Geophysics.

The amount of waste generated in Alberta is in-creasing annually due to increases in population and industrial activity. To accommodate the waste and industrial activity. To accommodate the waste and to mitigate the impact of waste disposal facilities on groundwater resources, it is essential to employ site selection criteria. Further, to monitor the long term effects of landfill facilities on groundwater quality, it is essential groundwater monitoring systems be installed. Alberta has made a positive move toward protecting groundwater quality by establishing the regional landfill concept. The number of small scale dumps is decreasing since more municipalities can afford proper waste disposal. Regional landfills are operated as anitary landfills where refuse is compacted daily and covered with soil. Groundwater monitoring systems are installed at all regional landfills and selected smaller facilities. These systems consist of strategically located piezometers and water table strategically located piezometers and water table
wells which are sampled at a frequency contingent
upon the contamination potential of the site. Monitoring activities are organized annually by compil-

ing a schedule. Present and future monitoring activities will put a stress on present manpower and funds. To cope with this difficulty, innovative techniques are being sought to streamline monitoring activities. Computer storage of groundwater monitoring data is planned to cone with the itoring data is planned to cope with t sed amount of data. Geophysical tech with the inare being explored as methods to quickly evaluate groundwater contamination from waste facilities. (See also W87-05071) (Lantz-PTT)

VERTICAL MOVEMENT OF GROUND WATER UNDER A LANDFILL, ANCHORAGE, ALASKA, Geological Survey, Anchorage, AK. Water Resources Div.

For primary bibliographic entry see Field 2F. W87-05096

LABORATORY EVALUATION OF SLURRY WALL MATERIALS OF CONSTRUCTION TO PREVENT CONTAMINATION OF GROUND-WATER FROM ORGANIC CONSTITUENTS, Davis (Ken E.) Associates, Houston, TX.
For primary bibliographic entry see Field 5G.
W87-05098

GROUND WATER QUALITY MANAGEMENT AT A CONCENTRATED WASTE SITE, Henningson, Durham and Richardson, Inc., St. Petersburg, FL. For primary bibliographic entry see Field 5G. W87-05099

RELATION OF GROUNDWATER QUANTITY

AND QUALITY.

International Association of Hydrological Sci-For primary bibliographic entry see Field 2F. W87-05100

EFFECT OF IRRIGATED AGRICULTURE ON EFFECT OF IRRIGATED AGRICULTURE ON UNDERLYING GROUNDWATER, Agricultural Research Service, Phoenix, AZ. Water Conservation Lab. For primary bibliographic entry see Field 5C. W87-05102

GROUNDWATER CHANGES IN THE URBAN AREA OF WROCLAW IN THE PERIOD 1874-

1974, Akademia Rolnicza, Wrocław (Poland). Inst. of Hydro- and Geotechnics. For primary bibliographic entry see Field 2F. W87-05105

STOCHASTIC MODELLING OF SOLUTE TRANSPORT BY GROUNDWATER FLOW: STATE OF THE ART, Tel-Aviv Univ. (Israel). Dept. of Fluid Mechanics and Heat Transfer.

and Heat Transfer.

G. Dagan.
IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 91-101, 4 fig, 12 ref.

Descriptors: *Solute transport, *Groundwater movement, *Stochastic process, *Model studies, Dispersivity, Heterogeneity, Transmissivity, Path of pollutants, Permeability coefficient.

The inadequacy of the traditional approach of modelling transport in large porous formations by using a deterministic differential equation with a constant dispersivity is discussed. The apparent variation of dispersivity with distance in field tests and the uncertainty of prediction are emphasized. A stochastic model of transport governed by the large-scale heterogeneity of hydraulic conductivity is outlined. Two scales, the local and the regional are set forth. The local scale is of the order of the aquifer depth, and heterogeneity has a three-di-

mensional structure, with correlation scale of order mensional structure, with correlation scale of order of meters. The regional scale is of the order of the horizontal extent of the aquifer; variables are averaged over depth and become functions of two variables in the plane. The transmissivity correlation is modelled as a random function of space and time, reflecting the uncertainty of the spatial distribution of hydraulic conductivity or transmissivity. The concentration mean is shown to satisfy an equation of transport with travel time dependent dispersivities. At regional scale the concentration is equation to transport with travel time dependent dispersivities. At regional scale the concentration is subject to large uncertainty. (See also W87-05100) (Author's abstract) W87-05108

RANDOM WALK METHOD FOR THE SIMULATION OF MACRODISPERSION IN A STRATIFIED AQUIFER, Rijksinstituut voor Drinkwatervoorziening, Leidschendam (Netherlands). For primary bibliographic entry see Field 2F. W87-05109

INFLUENCE OF MICRO- AND MACRO-STRUCTURE OF AQUIFERS ON THE SPREADING OF POLLUTANTS, Vizgazdalkodasi Tudomanyos Kutato Intezet, Bu-

Vizgazdalkodasi 7 dapest (Hungary). G. Kovacs.

dapest (rlungary).

G. Kovacs.

IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 115-121, 3 fig, 2 ref.

Descriptors: *Aquifer characteristics, *Path of pol-lutants, *Groundwater pollution, Mechanical dis-persion, Groundwater movement, Permeability co-efficient, Dispersivity, Mathematical models,

The main physical process influencing the spreading of pollutants in aquifers is mechanical dispersion. Several similarities were noted between mechanical dispersion caused by macroscopic structural elements of aquifers and the distribution of concentration due to bifurcation in microscopic channels of water transport and their random structure. The major difference was that with microscopic structures the expected value of concentrations of the procession o structure. The major difference was that with microscopic structures, the expected value of concentration is independent of the relative variance of the individual microscopic elements, while in dealing with macroscopic structures the longitudinal decrease in concentration diminished as variability is reduced in the hydraulic conductivity of the blocks comprising the flow domain (concentration was constant when the relative variance in hydraulic conductivity was zero since macroscopic mechanical dispersion was absent in a homogeneous field). The recognition of both similarities and differences in concentration fields due to structure field). The recognition of both similarities and dif-ferences in concentration fields due to structure offers the potential for adapting mathematical models to describe concentration distributions in flow domains with randomly changing macroscop-ic structure. Longitudinal distortion attributable to macroscopic structure can be determined on a scale consistent with the variance of hydraulic conductivity. (See also W87-05100) (Lantz-PTT) W87-05110 W87-05110

SIMULATION OF SOLUTE TRANSPORT IN AQUIFERS BY MEANS OF A MATHEMATI-CAL MODEL WITH LITTLE NUMERICAL DIFFUSION (SIMULATION DU TRANSPORT DE POLLUANT DANS LES NAPPES PAR UN MODELE A FAIBLE DIFFUSION NUMERI-

QUED,
Electricite de France, Paris.
J. P. Bouchard, and P. Lencioni.
IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 123-129, 2 fig, 6 ref.

Descriptors: *Solute transport, *Simulation analysis, *Mathematical models, *Aquifers, *Simulation

Sources Of Pollution-Group 5B

analysis, *Path of pollutants, Permeability coeffi-cient, Porous media, Advection, Mathematical

A description is given of the difficulties which appear in modelling the physical phenomena involved in solute transport in porous media. A model was developed which solves the flow and transport equations by means of a finite difference method. The advection step is solved by an algorithm based on the so-called two-dimensional method of characteristics which allows calculation with little numerical dispersion. The computer code has been applied to estimate the concentration evolution in the case of aquifer pollution. (See also W87-05100) (Author's abstract) W87-05110)

TRANSPORT OF POLLUTANTS AND SCALE EFFECTS (TRANSPORT DE POLLUTANTS ET EFFETS D'ECHELLE), Montpellier-2 Univ. (France). F. Brissaud.

IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 131-143, 8 fig, 20 ref.

Descriptors: *Path of pollutants, *Groundwater movement, *Aquifers, Solute transport, Permeabil-ity coefficient, Alluvial aquifers, Homogeneity, Model studies, Mathematical equations, Mathema-ical analysis, Flow profiles, Flow velocity, Disper-

Dispersion associated with the transport of non-interactive solutes in aquifers results from the dis-tribution of the water velocity caused by the spa-tial variability in the permeability of the natural medium. Modelling tracer transport, for instance by using the dispersion equation, requires the scale of fluid flow to be great enough in relation to the size of the elements determining the distribution of water velocity. These elements are at the millimet-ric scale in a disturbed homogeneous medium and at the metric or decametric scale in an aquifer. This may explain why the dispersion equa-tion is consistent with kilometric propagation simu-lations as well as with solute transport in homoge-neous laboratory columns. This may explain, too, the difficulties encountered when modelling and extrapolating the data of aquifer tracer tests to the decametric scale. (See also W87-05100) (Author's abstract) abstract)

HEAT AND MASS TRANSPORT IN SATURAT-ED-UNSATURATED GROUNDWATER FLOW, Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Wasserbau und Wasserwirtschaft und Inst. fuer Wasserbau. For primary bibliographic entry see Field 2F. W87-05114

SALT CONTAMINATION OF A COASTAL CONFINED AQUIFER,
Mie Univ., Tsu (Japan). Dept. of Geography.

K. Mori. IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146, p 219-225, 6 fig. 1 tab, 5 ref.

Descriptors: *Saline water intrusion, *Groundwater pollution, *Water pollution sources, *Coastal aquifers, *Confined aquifers, *Japan, Groundwater quality, Kiso River, Nagera River, Ibi River, Chlorides, Groundwater depletion, Wells.

The quality of confined groundwater in the vicinity of the outlets of the Kiso, Nagara and Ibi Rivers in the central part of Japan was investigated to determine the origin of dissolved constituents. The concentration of chloride in groundwater showed a remarkable tongue distribution, having a maximum value of 2510 mg/L in the aquifer of 40-70 m

in depth. The area showing the highest concentration of chloride is located a short distance landward from a shoreline and coincides with an area
of high intensity of withdrawal. Aquifer leakage by
vertical downward movement of contaminated
phreatic groundwater through non-pumping wells
had an effect in lowering the quality of confined
aquifers. The extrusion of fossil water from marine
impermeable layers was a further source of dissolved material in confined groundwater. A mean
residence time of 30-40 years was deduced from
measurements of environmental tritium for
groundwater in the majority of basin. (See also
W87-05100) (Author's abstract)
W87-05100 (Valuthor's abstract)

SINGLE WELL MEASUREMENTS AS A TOOL FOR DECONTAMINATION OF AN ARSENIC CONTAMINATED GROUNDWATER PLUME,

CONTAMINATED GROUNDWATER PLUME, Kiel Univ. (Germany, F.R.). Geologisch-Palaeontologisches Inst. und Museum.

G. Matthess, H. Moser, and P. Trimborn.

IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the KVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 259-265, 2 fig. 1 tab, 4 ref.

Descriptors: *Test wells, *Groundwater pollution, *Arsenic, *Plumes, Cologne, West Germany, Industrial wastes, Effluents, Injection wells, Path of pollutants, Permeability coefficient, Aquifers, Manganese, Iron, Potassium, Deuterium, Zinc, Chemical prespiratorio

The groundwater in the vicinity of a former zinc ore smelter near Cologne, Federal Republic of Germany, was contaminated by arsenic compounds (up to 56 mg/L in 1971) from the flue gas wash. Its effluent, still containing traces of arsenic, seeped from the cribs into the aquifer. The aquifer consists of Pleistocene sands and gravels with intercalated layers of silt, clay and coarse gravel. Fine silty sands of Oligocene age underly the aquifer at depths between 18.5 and 27 m. Hydraulic conductivity of the aquifer is 0.00026 m/s with a limited range of variability between 0.0005 and 0.00037 m/s. The underlying layer of fine silty sand differs in hydraulic conductivity by approximately two orders of magnitude at 0.00001 m/s. A network of five injection wells and 41 piezometers of variable depth, including nested arrays, was installed in the contaminant ozone. This network provided an assessment of the dynamics in the distribution of the contaminant together with a determination of the flow regime in the contaminated plume. Treatment involved the injection of KMnO4 to precipitate arsenate complexes in the pentavalent form in combination with manganese or iron, or as a co-precipitant with manganese dioxide. The in situ treatment was enhanced by changes in the direction and rate of groundwater flow. An understanding of this important coupled response to eliminate arsenic has been facilitated by the use of radiohydrometric single well measurements in 1974 and 1975, of deuterium analyses in groundwater and Rhine discharge and of groundwater contour maps. (See also W87-05100) (Lantz-PTT) W87-05123 groundwater (Lantz-PTT) W87-05123

DETECTION OF SUBSURFACE SEEPAGE BE-TWEEN AQUIFERS BY HYDROCHEMICAL AND ENVIRONMENTAL ISOTOPIC TECH-NIQUES - A CASE STUDY FROM SOUTH AUS-

NIQUES - A CASE STUDY FROM SOUTH AUSTRALIA,
FINALIA,
Flinders Univ. of South Australia, Bedford Park.
L. M. Ramamurthy, and J. W. Holmes.
IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the
XVIIIth General Assembly of the International
Union of Geodesy and Geophysics, Hamburg, FR
Germany, August, 1983. IAHS Publication No.
146. p 267-282, 7 fig, 4 tab, 12 ref.

Descriptors: *Path of pollutants, *Seepage, *Aquifers, *Isotopic tracers, *Case studies, *Groundwater movement, Uranium radioisotops, Deuterium, Tritium, Confined aquifers, Bicarbon-

The rising salinities and sources of recharge to a confined aquifer by vertical seepage from an overlying unconfined aquifer and by lateral seepage from a fresh water lake were investigated using major ions and environmental isotopes 234-U, 23faminates obtained by flownet analyses were not substantiated by physical groundwater modelling. Rather, the studies support the prevailing opinion of the authorities and farmers, that vertical seepage is from point sources possibly due to faulty, corroded and leaky borehole casings which form an effective hydraulic connection between the two aquifers. It is feasible to identify these sources of leakage on the basis of HCO3(-) U, and 2-H content of groundwater. The increase in salinity at any particular point in the aquifer, over a period of time could be caused by vertical seepage of saline water from the unconfined aquifer or by lateral flow of high salinity waters from the outlying flanks of the aquifer itself. Both of these effects could be resolved, and even quantified on the basis of a (HCO3(-), U) plot. This involves extensive hydrochemistry, both in space The rising salinities and sources of recharge to a quantified on the basis of a (HCO3(-), U) plot. This involves extensive hydrochemistry, both in space and time, the viability of which could only be determined by its practical use. The study reveals that a good correlation between HCO3(-) and uranium concentration, if found in groundwater aquifers, could be effective in fingerprinting consultative bodies and sometimes in qualitative aquiters, could be effective in fingerprinting groundwater bodies and sometimes in qualitative and quantitative determination of mixing that might occur between them. Such a concept, which should invariably be used in the context of the overall hydrogeological setting and with complementary data on environmental isotopic tracers, and major ions, could be a useful tool in hydrological investigations. (See also W87-05100) (Lantz-PTT) W87-05124

GROUNDWATER CHEMISTRY IN THE HAM-BURG REGION, Geologisches Landesamt Hamburg (Germany,

Geologisches Landesamt Hamburg (Germany, F.R.).
J. Ehlers, and J. Grieger.
IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publications No. 146. p 285-293, 4 fig, 18 ref.

Descriptors: *Groundwater pollution, *Saline water intrusion, *Salinization, *Chemical analysis, *Path of pollutants, *Hamburg, *West Germany, *Water pollution sources, Aquifers, Water analysis, Groundwater movement, Nitrates, Sulfates, Chlorides, Gypsum, Saline water intrusion.

Salinization is a major problem affecting the utilization of Hamburg's groundwater. There are two main reasons for this: saline water intrudes into the upper aquifers from the Elbe River and from the upper aquifers are highly mineralized due to the solution of gypsum at the flanks and on the tops of the salt domes due to ascending salt water. Contaminant discussed are sulfates, nitrates and chlorides. So far, the local anthropogenic contamination (e.g. around garbage dumps and on industrial estates) is not discussed here. In the agricultural areas there is a widespread earichment of nitrate, especially in areas with high infiltration rates. The slight enrichment of chloride in the upper aquifer in the city area is most likely a result of salting of the roads in winter. (See also W87-05100) (Author's abstract) thor's abstract) W87-05125

GEOGENIC GROUNDWATER POLLUTION IN THE HAMBURG REGION, FR GERMANY, M. Schulz, and K. Wichmann.

M. Schutz, and K. Wichmann.
In: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 295-306, 13 fig. 9 ref.

Descriptors: *Groundwater pollution, *Hamburg, *West Germany, *Water pollution sources, Saline

Group 5B-Sources Of Pollution

water intrusion, Water quality control, Ground-water quality, Permeability coefficient, Aquifers, Humic acid, Leachates, Groundwater manage-

ment.

The town of Hamburg and its environs with two million inhabitants is supplied by 21 waterworks. Water for human use is drawn from three main aquifers. In some parts of the region deep Tertiary aquifers suffer geogenic pollution from humic acid and salt water, depending on groundwater abstractions. The salt water many originate from either ieachates of salt domes, ascending formation waters or fossilized ocean water. A control system using several methods is presented: regionally, geoelectrical soundings and analyses of mixed water samples from observation on wells give a perspective of the overall situation. locally, conductivity measurements have been undertaken in special 125 millimeter observation wells, to locate filters throughout the length of each of the permeable strata. These data, in time and space, provide a complete picture of the salt water/fresh water distribution in the aquifers. Three case studies are presented. The control mechanisms enable efficient water quality management. (See also W87-05100) (Author's abstract) W87-05126

HYDROGEOCHEMISTRY OF GROUNDWAT-Jawaharlal Nehru Univ., New Delhi (India). School of Environmental Sciences. For primary bibliographic entry see Field 2F. W87-05127

RCRA PERMITTING: CASE HISTORIES, ACLS, TRICHLOROETHYLENE AND PENTACHLOROPHENOL, Sweet, Edwards and Associates, Inc., Kelso, WA.

For primary bibliographic entry see Field 5G. W87-05130

MULTI-PHASE TRANSPORT OF PETROLE-UM HYDROCARBONS IN THE SUBSURFACE ENVIRONMENT: THEORY AND PRACTICAL

EA Engineering, Science, and Technology, Inc., Sparks, MD.

Sparts, M.D.

R. E. Hinchee, and H. J. Reisinger.

IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 58-76, 7 fig, 4 tab, 9 ref.

Descriptors: "Path of pollutants, "Groundwater pollution, "Hydrocarbons, "Multiphase flow, Groundwater movement, Density, Vapor pressure, Viscosity, Hydrophobicity, Chemical analysis, Oil

Hydrocarbon transport in the subsurface environment occurs in several phases including bulk liquid, dissolved, and vapor phases. Mechanisms that influence transport include the physicochemical properties of the specific compounds present such as density, vapor pressure, viscosity, and hydrophobicity as well as the physical and chemical properties of the subsurface environment including geology and groundwater hydrology. Hydrocarbon liquids are typically complex mixtures composed of numerous compounds, each with its own bon liquids are typically complex mixtures com-posed of numerous compounds, each with its own individual physicochemical and, therefore, trans-port properties. Examination of chemical data can provide insights into the transport mechanisms op-erating at a site. Groundwater transport results in relative enrichment by more soluble, less hydro-phobic hydrocarbon compounds as a function of distance from a spill. Vapor phase transport typi-cally results in relative enrichment in more volatile hydrocarbon compounds. An understanding of cally results in relative enrichment in more volatile hydrocarbon compounds. An understanding of transport mechanisms is instrumental in assessing contamination, source identification, predicting contaminant fate, and design of an appropriate remedial program. (See also W87-05128) (Author's abstract)

MIGRATION AND APPARENT SUBSURFACE BIODEGRADATION OF ORGANIC COMPOUNDS IN A FRACTURED BEDROCK AQUI-

FER,
Dames and Moore, Cranford, NJ.
C. Tsentas, and D. J. Supkow.
IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 77-89, 5 fig, 2 tab, 1 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Organic compounds, *Aquifers, *Ground-Descriptors: Yan of pointants, "Fate of pointants, and granic compounds, "Aquifers, "Groundwater pollution, Chemical analysis, Tetrachloroethylene, Biodegradation, Volatile organics, Plumes, Groundwater movement.

A spill of an unknown volume of tetrachloroethy-lene over an eight-year period contaminated the groundwater in a shallow bedrock aquifer in cen-tral New Jersey. In addition to tetrachloroethy-lene, several other organic compounds were de-tected in groundwater samples. No free-phase te-trachloroethy-lene was detected, thereby suggest-ing that the entire spill was adsorbed on the soil surfaces in the unsaturated and saturated copes at trachloroethylene was detected, thereby suggesting that the entire spill was adsorbed on the soil surfaces in the unsaturated and saturated zones at or near the spill site. Volatile organic groundwater contaminants, primarily tetrachloroethylene, have migrated to the southeast within the northwest-southeast trending bedrock fracture zone. The contaminants appear to be confined to the fracture zone and are not migrating laterally outside this zone. Some contaminants have migrated vertically into the deeper of the bedrock aquifer. Convergence of clean groundwater into the fracture zone is causing dilution of the contaminants as they migrate toward the southeast. The zone of peak concentration of volatile organic contaminants is currently remaining in the vicinity of the spill site. Dilution of the contaminants flow along the fracture zone gives the appearance that the contaminant plume is not migrating. The detection in the groundwater of some organic contaminants not known to have been spilled suggests that they may be the result of the biodegradation of tetrachloroethylene in the subsurface. (See also W87-05128) (Lantz-PTT) (Lantz-PTT) W87-05134

GROUND-SURFACE INTERACTION IN PRO-MOTION OF CONTAMINATION BY UNDER-GROUND STORAGE TANK LEAKAGE: A

CASE STUDY, Southern Methodist Univ., Dallas, TX. Center for

Southern Methodist Univ., Dallas, TX. Center for Urban Water Studies.

M. A. Collins.

IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 90-110, 3 fig, 4 tab, 27 ref.

Descriptors: *Groundwater pollution, *Underground storage, *Leakage, *Path of pollutants, Case studies, Hydrocarbons, Gasoline, Fate of pollutants, Water table, Soil contamination, Storage

During the period of 1978 thru 1982, hydrocarbon fuel was found in a telephone manhole at an intersection in a small city in North Central Texas on four different occasions. The underground fuel storage tanks at three different gasoline service stations were possible sources of this fuel. While comparison of recovered fuels to fuels from the potential sources using gas chromatography (GC) indicated one station as the more probable source, the GC analyses were not conclusive. Analysis strongly supports the hypothesis that gasoline leakthe GC analyses were not conclusive. Analysis strongly supports the hypothesis that gasoline leakage from subsurface storage tanks and/or piping was carried to the vicinity of the telephone conduit draining to the telephone manhole located at Avenues N and E as a result of moisture penetrating unsaturated soils in the vicinity of gasoline accumulations and, possibly in addition, locally rising water tables lifting gasoline accumulations to conduit levels and thus facilitating gasoline entry into the telephone conduit. Furthermore, the temporal

occurrence and amounts of precipitation events also indicate that the most probable source of such gasoline accumulations was the Station A site storage tanks and/or piping leading to or from such storage tanks. Data on unaccounted for gasoline further support this conclusion. This case study demonstrates the importance of the combined effects of surface recharge and subsurface transport in accounting for the migration of hydrocarbon products from underground storage tanks. Because such tanks are typically at shallow depths, direct surface recharge can be very influential in producing a flushing effect which, as in the present study, may be accentuated by subsurface geology which can tend to slow or retain downward percolating waters. Simple analytical models are, in the presence of limited data, appropriate for providing reasonable estimates of the temporal behavior of moving fluids in order that contamination events can be correlated with surface recharge behavior. The temporal nature of surface recharge can be very significant in yielding an obvious quasi-periodic behavior to the occurrence of contamination events. (See also W87-05128) (Lantz-PTT)

ASSESSMENT OF COAL TAR CONSTITUENTS MIGRATION: IMPACTS ON SOILS, GROUND WATER AND SUFFACE WATER, Northeast Utilities Service Co., Hartford, CT. For primary bibliographic entry see Field 5C. W87-05136

BIOTRANSFORMATION OF GASOLINE HY-DROCARBONS IN METHANOGENIC AQUI-FER MATERIAL, Oklahoma Univ., Norman. Environmental and Ground Water Inst.

Ground Water Inst.
B. H. Wilson, and J. F. Rees.
IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 128-139, 3 fig., 1 tab, 18 ref. USAF Interagency Agreement No. RW57930615-01-1 with the EPA.

Descriptors: *Fate of pollutants, *Biodegredation, *Biotransformation, *Hydrocarbons, *Gasoline, *Aquifers, *Chemical analysis, Methanogenic material, Oil pollution, Groundwater pollution, Benzene, Leachates, Toluene, Ethylbenzene, Dimethylbenzene, Degradation, South Canadian River.

Leaks and spills, especially petroleum products, are one of the leading sources of groundwater pollution. Four compounds characteristic of a weathered gasoline spill were studied in authentic aquifer material (alluvium from the floodplain of the South Canadian River) that receives municipal the South Canadian River) that receives municipal landfill leachate and is known to support methanogenesis. They were: benzene, methylbenzene (toluene), ethylbenzene, and 1,2-dimethylbenzene (0-xylene). All manipulations were done in an anaerobic glovebox to insure the maintenance of methanogenic conditions. The treatments were: (1) aquifer ogenic conditions. The treatments were: (1) aquifer material plus alkylbenzenes, (2) aquifer material plus alkylbenzenes and nutrients, (3) aquifer material plus alkylbenzenes and (3) aquifer material without alkylbenzenes, and (5) aquifer material without alkylbenzenes. Initial concentrations were approximately 600 micrograma/L for benzene and toluene and 250 micrograms/L for benzene and toluene and 250 micrograms/L for ethylbenzene and 6-xylene. All of the compounds were degraded in the anaerobic subsurface material with or without nutrients. Toluene degradation was apparent after six weeks. At the end of twenty weeks of out nutrients. Toluene degradation was apparent after six weeks. At the end of twenty weeks of incubation the concentration of toluene was reduced by 80% of the original amount. Benzene and o-xylene were reduced by 20%, and ethylbenzene was reduced by 12%. Significant degradation of all compounds occurred after 40 weeks of incubation. The concentration of toluene was reduced by 98%, that of benzene was reduced by 72%. The concentrations of ethylbenzene and 0-xylene were reduced by 74% and 78%, respectively. The compounds did not degrade in autoclaved aquifer material or water, implicating a biological process. Disappearance of toluene was rapid; the other compounds required considerable lag time before

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degradation occurred. (See also W87-05128) (Author's abstract)

MICROBIAL DEGRADATION KINETICS OF ALCOHOLS IN SUBSURFACE SYSTEMS, Virginia Polytechnic Inst. and State Univ., Blacks-burg. Dept. of Civil Engineering. K. D. White, J. T. Novak, C. D. Goldsmith, and S.

Bevan.

IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 140-159, 9 fig. 4 tab, 7 ref.

Descriptors: *Degradation kinetics, *Alcohols, *Groundwater, *Microbial degradation, *Biodegradation, *Fate of pollutants, Groundwater pollution, Methanol, Tertiary butyl alcohol, Gasoline, Aquifers, Anaerobic conditions.

Aquifers, Anaerobic conditions.

The subsurface biodegradation rates of methanol and tertiary butyl alcohol (TBA), two compounds used commercially as gasoline additives, were studied. Four locations were chosen for subsurface soil and groundwater sampling: Dumfries, VA, Philadelphia, PA, Williamsport, PA, and Wayland, NY. One of the sampling sites had been previously contaminated for several years with gasoline containing tertiary butyl alcohol. Significant bacterial populations were found to exist in all subsurface samples, down to depths of 100 feet. In an aerobic aquifer, both methanol and tertiary butyl alcohol were found to biodegrade readily. Pristine, anaerobic groundwater systems also exhibited high methanol utilization rates. However, under these groundwater conditions, tertiary butyl alcohol was only slowly biodegraded. Complete utilization of tertiary butyl alcohol never occurred in pristine, anaerobic aquifers. Contamination of an aquifer by gasoline had no observed effect on methanol biodegradation, but seemed to cause an enhancement of tertiary butyl alcohol biodegradation. In this anaerobic contaminated groundwater system, TBA utilization proceeded slowly initially, similar to uncontaminated systems, then increased dramatically after 40 days. Anaerobic TBA utilization rates were first order with respect to initial subcally after 40 days. Anaerobic TBA utilization rates were first order with respect to initial substrate concentration in both contaminated and prisstrate concentration in both contaminated and pris-tine systems. Kinetic analysis revealed that TBA biodegradation in the contaminated system could be predicted from laboratory data and extrapolated to lower temperatures. (See also W87-05128) (Au-thor's abstract) W87-05128

NATURAL ATTENUATION OF AROMATIC HYDROCARBONS IN A SHALLOW SAND AQ-

UIFER, Waterloo Univ. (Ontario). Dept. of Earth Sciences. J. F. Barker, and G. C. Patrick. IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 160-177, 7 fig, 1 tab, 13 ref.

Descriptors: *Fate of pollutants, *Path of pollutants, *Hydrocarbons, *Aromatic compounds, *Aquifers, *Biodegradation, Oil pollution, Benzene, Toluene, Xylenes, Gasoline, Groundwater pollution, Groundwater movement, Oxygen.

Inadvertent release of petroleum products such as gasoline into the subsurface can initiate ground-water contamination, particularly by the toxic, water-soluble and mobile gasoline components: benzene, toluene and xylenes (BTX). This field-oriented research study was undertaken to examine the processes controlling the rate of movement and the persistence of dissolved BTX in groundwaters in a shallow, unconfined sand aquifer. In this paper, the natural attenuation of BTX is emphasized. BTX-spiked groundwater was introduced below the water table and this migration of contaminants through a dense sampling network was monitored. BTX components migrated slightly slower than the groundwater due to sorptive retar-

dation. Essentially all the injected mass of BTX was lost within 434 days due to biodegradation. Rates of mass loss were highest for m- and p-xylene, lower for p-xylene, lower for o-xylene and toluene and lowest for benzene which was the only component to persist beyond 270 days. Laboratory biodegradation experiments produced similar rates. A dominant control over BTX biodegradation is the availability of dissolved oxygen. BTX persisted at the field site in layers low in dissolved oxygen. Decreasing mass loss rates over time observed in the field experiment are not likely due to first-order degradation rates, but rather to the persistence of small fractions of BTX mass in anoxic layers. (See also W87-05128) (Author's abstract) W87-05139

SORPTION AND DESORPTION OF DE-GREASING CHLOROORGANICS WITH SUB-

SURFACE SEDIMENTS, Missouri Univ-Rolla. J. C. Huang, B. A. Dempsey, S. Y. Chang, and H. Ganjidoost.

Ganjidoost.

In: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWW A/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 178-188, 7 fig, 1 tab, 4 ref.

Descriptors: *Sorption, *Description, *Path of pol-lutants, *Fate of pollutants, Subsurface sediments, Sediment contamination, Tetrachloroethylene, Trichloroethylene, Trichloroethane, Bentonite clay, Chemical analysis, Volatile organics, Groundwater pollution, Soil contamination.

The adsorption and desorption of three chloroorganic solvents, i.e., tetrachloroethylene (or perchioroethylene, PCE), trichloroethylene (TCE) and trichloroethylene, PCE), trichloroethylene (TCE) and trichloroethane TCA) by selected sediment materials were evaluated. The adsorption and desorption of these chloroorganics with bentonite clay is reported. Considerable efforts were devoted to developing proper experimental protocols because the three chloroorganics are extremely volatile and may be easily lost to the atmosphere from the test system during the adsorption experiment or extraction process. The experimental data suggest that bentonite clay is not a strong adsorber for PCE, TCE, and TCA. Other soil minerals that are similar to bentonite should not be expected to have a strong adsorption for the volatile chloroorganics. However, it must also be realized that, from the difference in the partition coefficients between adsorption and desorption reactions due to the so-called 'solids effect', once the chloroorganics become adsorbed by the bentonite, they will take a much longer time to become desorbed than the original adsorption reaction. The significance of this is it will greatly influence the speed of future groundwater cleanup through the pumpage and air stripping operation. Soils with higher total organic arbon content are being tested for their adsorptive capacities for the volatile organic solvents. It is expected that the extent of adsorption and desorption will be greater, but the rates of adsorption and desorption of the sorptive capacities and the reaction rates for higher concentrations of solutes. The rate of dissorbider concentrations of solute of the sorpive capacities and the reaction rates for higher concentrations of solutes. The rate of dissolution of volatile chlorinated hydrocarbons from pure phase droplets is considered to be an important parameter when neat material has entered the ground. (See also W87-05128) (Lantz-PTT) W87-05140

EFFECTS OF CLAY MINERAL-ORGANIC MATTER COMPLEXES ON GASEOUS HYDROCARBON EMISSIONS FROM SOILS,

Radian Corp., Austin, TX. C. G. Manos, K. R. William

C. G. Manos, K. R. Williams, W. D. Balfour, and S. J. Williamson. IN: Petroleum Hydrocarbons and Organic Chemi-cals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Pro-ceedings of the NWWA/API Conference, Novem-ber 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 189-206, 3 fig, 5 tab, 7 ref.

Descriptors: *Path of pollutants, *Clays, *Organic matter, *Hydrocarbons, *Soil contamination, *Ad-

sorption, Volatile organics, Pentane, Soil columns, Emissions, Organic compounds.

The first objective of this study was to determine if adsorption must be considered in volatile organic compound (VOC) vapor emission models of gas movement through soils. If adsorption effects were found to be significant, the second objective was to evaluate the effects of surface area and surface reactivity on adsorption. Liquid n-pentane was placed into the bottom of a soil column containing incorporations of silt plus clay into sand and the resulting n-pentane gaseous emission concentraincorporations of silt plus clay into sand and the resulting n-pentane gaseous emission concentrations measured over a twenty-four hour period. N-pentane emission concentrations were reduced by one percent for every percent incorporation into sand of the undisturbed silt plus clay fraction containing clay mineral-organic matter complexes. N-pentane emission concentrations were reduced by four percent for every percent incorporation into sand of the 400 C fired (organic matter removed) silt plus clay fraction. Incorporation of the 'less than 0.063 mm' (silt plus clay) fraction, taken from a natural soil (Houston Black Series), into Ottawa Sand matrix soil columns resulted in decreased emissions of n-pentane over a twenty-four period Sand matrix soil columns resulted in decreased emissions of n-pentane over a twenty-four period of monitoring. Similar results were obtained by incorporation of 400 C fired silt plus clay fractions into Ottawa Sand. Conclusions to be drawn are that both soil organic matter and clay mineral content of soils significantly affect VOC gaseous emissions from soils. Results of this study indicate that the form in which organic matter resides in soils determines the extent to which adsorption of VOCs may affect subsequent emission concentrations. (See also W87-05128) (Author's abstract) W87-05148 W87-05141

VOLATILE ORGANIC SCANS: IMPLICA-TIONS FOR GROUND WATER MONITORING, Lockheed Engineering and Management Services Co., Inc., Las Vegas, NV. R. H. Plumb, and A. M. Pitchford.

R. H. Plumb, and A. M. Pitchford.
IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWW A/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 207-222, 3 fig, 5 tab, 8 ref. EPA Contract Nos. 68-03-3050 and 68-03-3245.

Descriptors: *Monitoring, *Volatile organics, *Groundwater pollution, *Groundwater quality, Water quality control, Waste disposal, Hazardous wastes, Data interpretation, Organic compounds.

Water quality data from 183 hazardous waste disposal facilities were compiled to document the extent of groundwater contamination in the vicinity of these sites. The magnitude of the groundwater monitoring problem posed by these sites is demonstrated by the fact that 723 substances have been reported in the groundwater, the frequency of occurrence of each substance is highly variable, and the concentration range for each substance occurrence of each substance is highly variable, and the concentration range for each substance may span as many as seven orders of magnitude. The compiled data were used to evaluate the performance of the Indicator Parameters specified in the original RCRA Interim Status groundwater monitoring regulations. The evaluation suggested that the Indicators as presently used are inadequate monitors of changing groundwater quality conditions. An alternative approach for monitoring organic contamination of groundwater that relies on the use of volatile organic data was identified. The presentation of monitoring data as a cumulative frequency of detection of individual compounds within an analytical group (volatiles, acid extractables, base/neutrals, pesticides) produced a family of curves for which the volatile group was most abundant. This pattern was observed with national and regional data summaries whether results were expressed as a frequency of detection, an average concentration, or a maximum concentration. It is and the concentration range for each substance expressed as a frequency of detection, an average concentration, or a maximum concentration. It is suggested that volatile organic scans might be used as a screening technique to establish the extent of organic monitoring of groundwater needed at a hazardous waste disposal facility. (See also W87-05128) (Author's abstract)

Group 5B-Sources Of Pollution

SAMPLING FOR TRACE LEVEL DISSOLVED HYDROCARBONS FROM RECOVERY WELLS RATHER THAN OBSERVATION WELLS, Amoco Corp., Tulsa, OK.
Por primary bibliographic entry see Field 5G.
W87-05143

MONITORING OF UNDERGROUND STOR-AGE TANKS: CURRENT TECHNOLOGY, Weston (Roy F.), Inc., West Chester, PA. For primary bibliographic entry see Field 5A.

DEFINING EXTENT OF CONTAMINATION USING ONSITE ANALYTICAL METHODS.

Wooster Community Hospital, OH. B. J. Franka, D. F. Goerlitz, and M. J. Baedecker. The Petroleum Hydrocarbons and M. J. Bacdecker.

IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 265-275, 4 fig. 8 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Chemical analysis, Gas chromatography, Ptumes, Pensacola, Florida, Aromatic hydrocarbons, Nitrogen compounds, Methane, Drilling.

bons, Nitrogen compounds, Methane, Drilling.

Contaminant plumes from an abandoned woodpreserving plant near Pensacola, Florida, contain
numerous phenolic compounds, polynuclear aromatic hydrocarbons, and organic nitrogen compounds. Byproducts of microbial degradation, including methane, have also been identified. Interpretation of chemical analysis of earlier amples
shipped to the laboratory showed the complexities
of chemical distributions in the aquifer. Samples
were analyzed and evaluated within 1 hour of
collection, and this information was instrumental in
selecting the next drilling location. Concentrations,
all in milligrams per liter, of total phenolic compounds ranged from 0.00 to 116; total organic
nitrogen compounds, from 0.00 to 88; and total
polynuclear aromatic hydrocarbons (primarily
naphthalene and indene), from 0.00 to 19. Dissolved methane ranged in concentration from 0.0
to 14 milligrams per liter. Complex lithologic and
hydrochemical variability related to small-scale
heterogeneities in the aquifer made plume delineation a difficult task using conventional procedures.
Consequently, test holes were drilled and samples
collected from the drill stem for onsite analyses by
high performance liquid chromatography and gas
achromatography. Ranid analytical turnaround percollected from the drill stem for onsite analyses by high performance liquid chromatography and gas chromatography. Rapid analytical turnaround permitted frequent modifications of the original drilling plan to maximize plume delineation. Further, many potential problems related to choice of well casing material, sample preservation, shipping, and handling were avoided by the onsite capabilities. (See also W87-05128) (Lantz-PTT)

CASE HISTORY: SURFACE STATIC COLLEC-TION AND ANALYSIS OF CHLORINATED HYDROCARBONS FROM CONTAMINATED GROUND WATER,
Petrex, Golden, CO.
For primary bibliographic entry see Field 5A.
W87-05147

USE OF SOIL GAS SAMPLING TECHNIQUES FOR ASSESSMENT OF GROUND WATER CONTAMINATION, Warzyn Engineering, Inc., Madison, WI. For primary bibliographic entry see Field 5A.

ELECTROMAGNETIC MEASUREMENTS FOR SUBSURFACE HYDROCARBON INVESTIGA-

TIONS, Camp, Dresser and McKee, Inc., Annandale, VA. W. R. Saunders, and R. M. Germeroth. IN: Petroleum Hydrocarbons and Organic Chemi-cals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Pro-ceedings of the NWWA/API Conference, Novem-ber 13-15, 1985, The Westin Galleria, Houston,

Texas, 1986, p 310-321, 6 fig.

Descriptors: *Path of pollutants, *Fate of pollutants, *Chemical analysis, *Hydrocarbons, Conductivity, Geophysics, Electrical fields, Groundwater rollution, Plumes Remote sensing. es. Remote sen

uvity, Geophysics, Electrical fields, Groundwater pollution, Plumes, Remote sensing.

The use of terrain conductivity is a viable technique for delineating areas of subsurface hydrocarbons at Newark Airport. The technique appears to be limited to interpreting hydrocarbons thickness of 0.1 feet or greater. Areas in close proximity to terminal satellite buildings cannot be geophysically surveyed because of the high level of ambient electrical fields. Thicknesses of subsurface hydrocarbons for any given measurement may be inferred, but it is believed that the range of thicknesses are more appropriate as previously discussed. The area of subsurface hydrocarbon migration appeared to be widespread in the survey area. Due to the scope of this particular study, a definition of the full extent of the hydrocarbon migration at the Newark International Airport Central Terminal Area could not be defined. The hydrocarbon does appear to have a plume-like shape. Direction of plume flow could not be determined, but it appears that the terminal underdrains and surrounding drainage ditches do have some influence on hydrocarbon migration. It appears that leaky fuel hydrant pits may be a major source of the subsurface hydrocarbon accumulations. Interpretations of any remote sensing technique must be verified by monitor wells. It is not recommended nor concluded that this technique is a substitute for a well designed monitor well program. However, it is believed that the use of this geophysical technique is a viable option that should be discussed and reviewed for implementation at sites where hydrocarbons have leaked into the subsurface environment. It is important to understand that only qualified and experienced professional geophysicists should undertake a terrain conductivity survey for subsurface hydrocarbon accumulations.

NEW GROUND WATER SURVEY TOOL: THE COMBINED CONE PENETROMETER/ VADOSE ZONE VAPOR PROBE, McClelland Engineers, Inc., Houston, TX. S. T. Litherland, T. W. Hoskings, and R. L.

Boggess.

IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 322-330, 7 fig, 5 ref.

Descriptors: *Groundwater quality, *Laboratory equipment, *Cone penetrometer, *Vadose Zone Vapor Probe, Volatile organics, Unsaturated zone, Chemical analysis, Gas chromatography, Hydro-

A soil cone penetrometer has been modified to allow sampling of gases in the vadose zone. This tool was developed to obtain information concerning soil type and quantitative volatile organic compound data in the unsaturated zone simultaneously. The primary uses are in identifying leaks and locating contaminant plumes from underground storage tanks and pipelines, and surveying uncontrolled waste sites to strategically place exploratory borings and groundwater monitoring wells. The Cone Penetrometer/Vadose Zone Vapor (CP/VZV) probe consists of a gas collection barrel positioned is inches above the tip of the cone penetrometer. The tool is hydraulically advanced into the ground using a drill rig equipped with an automatic chuck assembly. Wiring from the cone penetrometer and tubing from the gas collection barrel are connected to aboveground equipment. Gas samples are anatubing from the gas collection barrel are connected to aboveground equipment. Gas samples are analyzed by either an organic vapor meter or portable gas chromatograph (GC) depending upon the information desired. The cone penetrometer is used to generate immediate feedback on soil stratigraphy. Depending on the type of soils encountered, gas sampling can be continuous with depth or only in porous soils as identified by the cone penetrometer data. The CP/VZV probe significantly reduces the time and cost of the investigation of sites

contaminated with volatile petroleum hydrocar-onbs and organic chemicals. It reduces the number of borings ultimately required by allowing more knowledgeable placement of exploratory borings and groundwater monitoring wells. By reducing the number of borings its use reduces the number of soil samples which must be taken, and hence, the potential exposure of the field personnel may also be reduced. (See also W87-05128) (Author's abstrace) W87-05150

INTERPRETATION OF GAS CHROMATOGRAPHY DATA AS A TOOL IN SUBSURFACE HYDROCARBON INVESTIGATIONS, Amoco Corp., Tulsa, OK.
R. B. Senn, and M. S. Johnson.
IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 331-357, 18 fig, 1 ref.

Descriptors: *Gas chromatography, *Hydrocarbons, *Groundwater pollution, *Data interpretation, *Path of pollutants, Chemical analysis, Fate of pollutants, Geohydrology, Gasoline, Sample preparation, Sampling, Monitoring.

preparation, Sampling, Monitoring.

Capillary column gas chromatography (GC) is an extremely useful aid in investigations of subsurface contamination of soil and groundwater by petroleum hydrocarbons. Information to define the extent of contamination frequently is obtained from observation wells installed for fluid level measurement and fluid sample collection. Interpretation of GC analysis of fluid samples in conjunction with other pertinent hydrogeologic data can facilitate the detection and migration of subsurface hydrocarbons. Interpretive techniques have been used for both qualitative and quantitative analysis of hydrocarbons in subsurface hydrocarbons in westigations. GC methods are used to detect and analyze petroleum hydrocarbons in dissolved and liquid phases. The concentrations of the aromatic hydrocarbon from gasoline products that dissolve in groundwater can be determined with extremely low limits of detection. Analysis of GC data also is used to obtain qualitative information from liquid hydrocarbon samples by determining the composition of hydrocarbon products. The relative age of sampled product can sometimes be estimated by degree of degradation from GC information. Deincomposition samples by determining the composition of hydrocarbon products. The relative age of
sampled product can sometimes be estimated by
degree of degradation from GC information. Determination of the hydrocarbon source and migration path can be made from GC analysis of fluid
samples collected at two or more locations. Interpretation of GC results in the laboratory without
consideration of pertinent hydrogeological information may lead to incorrect conclusions. Product
sample identification may be difficult because of
the differences in refined products, variations in
marketing distribution, and changes that occur in
the product in the subsurface. Interpretation of
water sample analyses can be complicated by volatilization of liquid hydrocarbons and sensitivity to
sampling and storage procedures before analysis.
(See also W87-05128) (Author's abstract)

TOLUENE LOSS INVESTIGATION AND RE-MEDIAL ACTION AT TWO GEOLOGICALLY COMPLEX INDUSTRIAL SITES IN EASTERN

tern-Sonderegger, Inc., Lincoln, NE.

Hoskins-Western-Sonderegger, Inc., Lincoln, NE. R.W. Elliott.
IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 374-396, 9 fig.

Descriptors: *Toluene, *Water pollution treatment, *Groundwater pollution, *Path of pollutants, *Nebraska, Geohydrology, Soil characteristics, Water sampling, Chemical analysis, Aquifers, Soil contamination, Clays, Geology.

A two-phase investigation of static and dynamic hydrogeologic conditions was adapted to two in-

Effects Of Pollution—Group 5C

dustrial sites of toluene losses. At each site, soil volatile emissions, auger borings, initial soil and water sampling, laboratory testing, and the appreciation of the geologic setting constituted Phase I, the static analysis Phase II, the dynamic analysis, included observation well construction, further soil and under secondary courses the static and construction and construction. included observation well construction, further soil and water sampling, acuifer testing, and eventual in-place testing of recovery/interception systems. The two-phase analysis resulted in remedial action recommendations that were site specific and could be used in design of less costly recovery/interception systems. Application of two-phase site specific investigations permitted cost effective design for remedial action in cases of both aquifer and soils contamination. Site One required hydraulic removal of toluene from an aquifer unit. Site Two required interception of toluene contaminated perched? groundwaters from sity clay soils mantling a thick sequence of glacial till. The two-phase analysis is recommended as a workable scenario for client/consultant/regulator cooperation profor client/consultant/regulator cooperation providing the highest level of efficiency and understanding for remedial action in complex geologic settings. (See also W87-05128) (Lantz-PTT) W87-05153

ADVANTAGE OF UTILIZING MULTIPLE RE-COVERY WELLS FOR AQUIFER RESTORA-

Groundwater Technology, Inc., Concord, CA. For primary bibliographic entry see Field 5G. W87-05155

DEGRADATION OF AROMATIC HYDROCARBONS WITH BACTERIA FROM OIL CONTAMINATED AQUIFERS,

Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.

B. Jensen, E. Arvin, and A. T. Gundersen.

B. Jensen, E. Arvui, and A. T. Oundersen.
IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 421-435, 6 fig, 7 tab, 14 ref.

Descriptors: *Biodegradation, *Fate of pollutants, *Hydrocarbons, *Aromatic compounds, *Bacteria, *Oil pollution, *Aquifers, Biodegradation, Water pollution treatment, Naphthalene, Fixed film, Groundwater pollution, Gasoline, Fuels, Cleanup

The biodegradation kinetics for naphthalene as a model compound were investigated in suspended growth and fixed film systems in the presence of oxygen. The degradability of one- and two ringed aromatic hydrocarbons was also studied with groundwater from oil contaminated aquifers. Microorganisms were able to degrade one- and two-ringed aromatic hydrocarbons down to 1 microgram/L or lower with a fairly high reaction rate, given sufficient oxygen and nutrients. With naphthalene as the only carbon and energy source the microorganisms in a fixed biofilm could easily degrade the hydrocarbon down to 1 microgram/L. The Monod constant, K sub s, appears to be about 1 microgram/L or even lower, which indicates a zero order reaction for naphthalene in the concentration range of practical interest. Normal expectations are that the reaction rate for organic compounds is first order in the microgram/L concentration range. If groundwater is taken from an anaerobic gasoline- or fuel oil contaminated area with no significant degradation activity, and oxygen and nutrients are then added, rapid degradation of the hydrocarbons down to one microgram/L. or less starts with little lag time. This requires an initial hydrocarbon concentration a considerable adaptation time may be expected. A high degradation potential by bacteria in the bulk groundwater in gasoline- and fuel oil contaminated area has been observed. These free flowing bacteria are transported by the groundwater, and consequently the bacteria may be important for degradation further downstream of the spill area. (See also W87-05128) (Lantz-PTT)

BIOTRANSFORMATION OF PETROLEUM HYDROCARBONS IN DEEP UNSATURATED SEDIMENTS, Geraghty and Miller, Inc., Oak Ridge, TN.
For primary bibliographic entry see Field 5G.

5C. Effects Of Pollution

FACTORS AFFECTING THE RESPONSE OF CUT GRASS TO THE NITROGEN CONTENT OF DAIRY COW SLURRY, National Inst. for Research in Dairying, Reading (England). For primary bibliographic entry see Field 5E. W87-04364

TOLERANCE OF HOLCUS LANATUS AND AGROSTIS STOLONIFERA TO SODIUM CHLORIDE IN SOIL SOLUTION AND SALINE

SPRAY, Liverpool Univ. (England). Dept. of Botany. For primary bibliographic entry see Field 3C. W87-04375

SOME OBSERVATIONS ON A CHOLERA OUTBREAK AT THE UMVOTI MISSION RE-SERVE, NATAL, National Centre for Ocupational Health, Johannes-

burg (South Africa). F. Sitas.

South African Medical Journal, Vol. 70, No. 4, p 215-218, August 16, 1986. 1 fig, 3 tab, 19 ref.

Descriptors: *Water pollution effects, *Path of pollutants, *Diseases, *Disease transmission, *Cholera, *Natal, *Socioeconomic conditions, *Ablution facilities, *Water supply, *Sanitation, Epidemics.

Between November 1981 and January 1982, 154 consecutive patients with cholera El Tor Inaba were hospitalized at Stanger hospital, Natal. These cases were traced to 130 households in the Umvoti Mission Reserve, which were ranked according to cases were traced to 130 households in the Umvoti Mission Reserve, which were ranked according to socio-economic condition, permanence of housing materials, ablution facilities, and purity of water source. Significant associations were found between cholera incidence and both socio-economic conditions and water source; the latter two were also strongly associated. In a number of instances, the outbreak did not follow the downstream flow of the rivers. Increased mobility and social gathering over the holiday season appears to have played a role in transmission. The atypical pattern of spread may also have resulted from non-water-borne, persons-to-person transmission. (Author's abstract)

UREA METABOLISM AND ITS SIGNIFICANCE IN THE NITROGEN CYCLE IN THE EUPHOTIC LAYER OF LAKE BIWA: IV. REGENERATION OF UREA AND AMMONIA, Osaka Kyoiku Univ. (Japan). Lab. of Environmental Science and Education.
For primary bibliographic entry see Field 2H.
W87-04406

FILTERING ACTIVITY OF DAPHNIA IN LOW CONCENTRATIONS OF A PESTICIDE, Warsaw Univ. (Poland). Dept. of Hydrobiology. M. Gliwicz, and A. Sieniawska. Limnology and Oceanography LIOCAH, Vol. 31, No. 5, p 1132-1138, September 1986. 4 fig, 1 tab, 27

Descriptors: *Water pollution effects, *Daphnia, *Pesticides, *Lindane, *Filtering activity, Lethal limit, Concentration, Molting, Diets, Sensitivity, Reproduction, Cladocera, Eutrophic lakes, Lakes,

It is believed that pesticides may amplify the ex-pression of eutrophication in lakes by reducing the abundance of filter-feeding zooplankton that other-wise might keep algal populations under control. Lakes enriched with nutrients from agricultural

land in their drainage basins are also frequently enriched with pesticides that are used along with fertilizers. The zooplankton populations of eutro-phic lakes enriched from agriculture are therefore phic lakes enriched from agriculture are therefore more frequently exposed to pesticides than those of oligotrophic lakes. A concentration of lindane (gamma-hexa-chlorocyclohexane) of 0.05 mg/liter, much lower than the 48-h lethal concentration (LC50) of 3.8 mg/liter, resulted in a 25% depres-sion in the frequency of movements of filtering limbs and mandibles of Daphnia pulex in a food-free medium. Different instars (from 2nd to 88th) were affected to the same extent. Animals 6-12 h after moliting were more sensitive than those 30.36 were affected to the same extent. Animals 6-12 h after molting were more sensitive than those 30-36 h after molting. Due to the greater number of molts before reproduction in larger Daphnia species, the effect of low pesticide concentrations may be size-selective and, therefore, responsible in part for the disappearance of large cladocerans from eutrophic lakes enriched from agriculture. (Alexander-PTT) W87-04435

EFFECT OF CADMIUM- AND ZINC-TREATED SLUDGE ON YIELD AND CADMIUM-ZINC UPTAKE OF CORN,

Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy. F. J. Sikora, and J. Wolt. Journal of Environmental Quality JEVQAA, Vol. 15, No. 4, p 341-345, October-December 1986. 7 tab, 26 ref.

Descriptors: "Water pollution effects, "Sludge, "Bioaccumulation, "Cadmium, "Zinc, "Corn, "Waste disposal, "Land disposal, "Crop yield, Wastewater treatment facilities, Loam, Tennessee, Roots, Chemical precipitation, Heavy metals, Solutes, Availability, Soil solution, Extraction, Competing use.

Land application of studge is sensible and economically feasible on farmlands in close proximity to wastewater treatment plants. Studge improves soil physical and chemical properties through the addition of organic matter and essential nutrients. However, land application of studge containing high concentrations of Cd, Zn, and other heavy metals may pose hexards. Cadmium and Zn reduce crop yield and Cd may reach potentially toxic levels in plant material. Studge obtained from a regional wastewater treatment plant in Tennessee was factorially treated with four levels each of Cd and Zn and amplied to Statler sandy loam surface was factorially treated with four levels each of Cd and Zn and applied to Statler andy loam surface soil (Humic Hapludults) sown to corn (Zea mays L.) in a greenhouse experiment. The highest Cd and Zn additions (75.1 and 759 mg/kg) soil, respectively, resulted in dry weight decreases of 19 and 25%, respectively, for corn tops and 47 and 56%, respectively, for corn tops and 47 and 56%, respectively, for corn topts. The 19% dry weight reduction at a Cd addition of 75.1 mg/kg soil was considerably less than values found in the literature. This comparatively modest dry weight reduction was attributed to a lower Cd availability due to Cd precipitation or binding in the sludge. Zinc effectively competed with Cd for uptake as evidenced by a decrease in Cd content of roots with increased Zn additions. On the contrary, Cd content of tops was not consistently decreased with increased 2st authoris. On the Contary, Act con-tent of tops was not consistently decreased with increased Zn application. An increase in the Zn levels of sludge was also found to increase the solubility of Cd in the sludge and soil. (Alexander-PTT) W87-04446

CHARACTERIZATION OF CADMIUM AND ZINC IN FOUR SOILS TREATED WITH SEWAGE SLUDGE,

NEWAGE SLUDGE, Auburn Univ., AL. Dept. of Agronomy and Soils. G. L. Mullins, and L. E. Sommers. Journal of Environmental Quality JEVQAA, Vol. 15, No. 4, p 382-387, October-December 1986. 1 fig, 6 tab, 35 ref. TVA Contract TV- 5864DA.

Descriptors: "Soil treatment, "Sludge, "Water pol-lution effects, "Waste disposal, "Land disposal, "Cadmium, "Zinc, Digested sludge, Loam, Barley, GEOCHEM, Computer programs, Soil solution, Concentration, Diffusion, Heavy metals, Ions, Ca-tions, Roots, Accumulation.

Group 5C—Effects Of Pollution

Plant uptake of Cd and Zn can be increased by applying sewage sludge to agricultural soils. Since Cd and Zn reach plant roots by the processes of root interception, mass flow, and diffusion, one or more of these trace element transport processes are altered by applying sludges to soils. Cadmium and Zn were characterized in soils treated with 100 Mg/ha of an anaerobically digested sewage sludge from Chicago, IL. The four soils included a Chalmers silt loam (Typic Haplaquolls) (Indiana), Celina loam (Aquic Hapludalfs) (Ohio), and a Plano silt loam (Typic Aquidolls) (Wisconsin). The single application of sludge supplied 19 kg Cd/ha and 340 kg Zn/ha. Four or five crops of barley (Hordeum vulgare L.) had been grown on each site prior to soil sampling. Soil solutions obtained by a centrifusation method contained Zn in the range of 1.4 to 10.5 micromol/L while Cd ranged from 18 to 135 mmol/L. The addition of sludge increased the concentration of both metals in the soil solutions of all four soils. Evaluation of soil solution data with the computer program GEOCHFM abound the Plant uptake of Cd and Zn can be increased by centration of both metals in the soil solutions of all four soils. Evaluation of soil solution data with the computer program GEOCHEM showed that >85% of the total soluble Cd and >91% of the total soluble Zn existed as the free metal ion. Sludge addition increased the amount of Cd and Zn extracted by DTPA and 4 M HNO3. The relative increases in soil solution and extractable Cd and Zn were different in each of the four soils even though the same sludge was applied at the same rate. Diffusion coefficients measured with a cation exchange resin paper method (D sub e), same rate. Diffusion coefficients measured with a cation exchange resin paper method (D sub e), ranged from 1.8 x 10 to the minus 11th power to 1.7 x 10 to the minus 1th power to 1.7 x 10 to the minus 1th power to 3.2 x 10 to the minus 10th power to 3.2 x 10 to the minus 10th power to 3.2 x 10 to the minus 10th power to 4.2 x 10 to the minus 10th power to 4.2 x 10 to the minus 10th power to 4.2 x 10 to the minus 10th power to 4.2 x 10 to the minus 10th power to 4.2 x 10 to the minus 10th power to 4.2 x 10 sou prl. Increases in the flux of Cd and Zn to plant roots in sludge-treated soils will be a reflection of changes in soluble and extractable Cd and Zn. (Alexander-PTT) W87-04448

EFFECT OF SIMULATED ACID PRECIPITA-TION ON SOIL MICROBIAL ACTIVITY IN A
TYPIC QUARTZIPSAMMENT, 11PIC QUARTZIPSAMMENT, Florida Univ., Gainesville. Dept. of Soil Science. M. E. Will, D. A. Graetz, and B. S. Roof. Journal of Environmental Quality JEVQAA, Vol. 15, No. 4, p 399-403, October-December 1986. 1 fig. 2 tab, 31 ref.

Descriptors: *Water pollution effects, *Simulated rainfall, *Acid rain, *Soil types, *Rainfall, *Microbiological studies, Enzymes, Irrigation, Respiration, Incubation, Mineralization, Acidity.

Acid precipitation has become a major environ-mental concern of the North American and Euro-pean scientific communities. The nature of the problem varies with the characteristics of the af-fected ecosystems and sources of the acid negrinipean scientific communities. The nature of the problem varies with the characteristics of the affected ecosystems and sources of the acid precipitation precursors. The major impact on aquatic and terrestrial ecosystems occurs where the average annual precipitation weighted pH of precipitation is <4.6 in combination with soils having a low cation exchange capacity (CEC) or the presence of exposed noncalcareous bedrock. The effects of acid precipitation on microbial and enzyme activities were determined in a field study near Melrose, FL. Three transects of two plots each were irrigated with lake water acidified with 7:3 (V/V) H2SO4/HNO3 to pH3.0 or 3.6, or with unacidified lakewater (pH 4.6, control) at a rate of 10 cm/week for 20 weeks. The experimental plots were divided into covered and uncovered subplots to determine the effect of excluding natural rainfall (pH 4.6). The application of 200 cm of simulated acid precipitation did not significantly influence soil pH, respiration, or aryisultatase activity. Phosphatase activity decreased under the pH 3.0 treatment and urease activity was stimulated by the pH 3.6 treatment. The accuracy of M invacedities over a 3.6 treatment. The accuracy of M invacedities over a 3.6 treatment. phatase activity decreased under the pH 3.0 treatment and urease activity was stimulated by the pH 3.6 treatment. The amount of N mineralized over a 12-week incubation period was lower in soil from the pH 3.0 treatment than in soil from the pH 3.6 and 4.6 treatments. After the application of 200 cm of simulated acid rain; soil pH, respiration, and phosphatase activity levels were lower in the plots protected from natural rainfall. Twenty-four weeks

after the last acid application there were no differences in any of the measured parameters between the pH treatments. (Alexander-PTT)

REVERSIBLE ARREST OF ARTEMIA DEVEL-OPMENT BY CADMIUM, Dalhousie Univ., Halifax (Nova Scotia). Dept. of

Biology.
P. Rafiee, C. O. Matthews, J. C. Bagshaw, and T. H. MacRae

Canadian Journal of Zoology CJZOAG, Vol. 64, No. 8, p 1633-1641, August 1986. 10 fig, 36 ref. NSERC (Canada) Operating grant A7661.

Descriptors: *Artemia, *Brine shrimp, *Water pollution effects, *Cadmium, *Hatching, *Population exposure, *Growth, *Reproduction, Emergence, Cysts, Membranes, Inhibition, Concentration, Morphology, Physiology, Microtubules, Aquatic organisms, Heavy metals.

The brine shrimp, Artemia, exhibits several characteristics that have facilitated its use in studies of developmental biochemistry, toxicology, and aquaculture. The organism can be obtained commercially in essentially unlimited amounts as dormant encysted gastralae and can be easily manipulated experimentally. Artemia is especially interesting because the encysted animals undergo an extensive relatively surphronous period of development experimentally. Artemia is especially interesting because the encysted animals undergo an extensive, relatively synchronous period of development in the absence of cell division allowing study of developmental processes separately from cell division appears to the continuous an encysted Artemia embryo undergoes a developmental process that culminates in the gradual, uninterrupted emergence of the prenauplius from the cyst. The hatching membrane surrounding the emerged organism is then ruptured, usually beginning at the posterior end, and a motile nauplius is released. This process was observed microscopically in the presence and absence of cadmium and it is reported that cadmium disrupts Artemia development in a dose-dependent manner. At 0.1 micro(u)M, cadmium slows emergence but nauplii eventually resume relatively normal development. Emergence and hatching are either delayed considerably or almost entirely prevented at 1 uM cadmium. Cadmium at 10 uM, completely arrests emergence but development continues at a reduced rate, eventualmium at 10 uM, completely arrests emergence but development continues at a reduced rate, eventually resulting in hatching of some organisms without need for complete emergence. If organisms exposed to 10 uM cadmium are washed, abnormally ahaped emerged forms are released and many of these eventually hatch, although in an unusual manner. Cadmium at 10 uM causes complete, rapid precipitation of purified Artemia tubulin at 0 C but cadmium at the lower concentrations tested has no apparent inhibitory effect on microtubule assembly. Although the actual cadmium-induced physiological changes that result in abnormal development. on microtubule assem-logical changes that result in abnormal develop-ment of Artemia are not known, the results indi-cate that the interdependence of morphological and molecular aspects of Artemia development can be examined in a way not previously possible. (Alexander-PTT)

EFFECT OF SHORT-TERM ACIDIFICATION DURING SPRING SNOWMELT ON SELECTED MOLLUSCA IN SOUTH-CENTRAL ON-

TARIO, Guelph Univ. (Ontario). Dept. of Zoology. M. R. Servos, and G. L. Mackie. Canadian Journal of Zoology CJZOAG, Vol. 64, No. 8, p 1690-1695, August 1986. 4 fig. 2 tab, 32 ref. NRC (Canada) Contract 0754-31048-0-3931.

Descriptors: *Acid precipitation, *Acidification, *Snowmelt, *Water pollution effects, *Mollusks, *Seasonal variation, *Lakes, Sulfuric acid, Hydrogen ion concentration, Sediments, Reproduction Clams, Snails, Population exposure, Ontario, Re

Acidification of freshwater environments due to Acidingation of resawater environments due to long-range transport and deposition of pollutants is well documented. Long-term acidification (years or decades) of aquatic environments usually occurs as the materials that readily assimilate acidic inputs in a watershed are slowly exhausted. However,

during periods of rapid runoff, such as spring snowmelt or heavy rainfall, the watershed may not be able to assimilate the acid inputs quickly enough and short-term (days or weeks) depressions of pH may occur. These episodic depressions may have a substantial impact on aquatic biota well before long-term acidification is even detectable. If so, it is possible that the impact of acidic precipitation is more severe than presently recognized. Limestone and sulfuric acid were used to manipulate the pH of water in three artificial channels in the outflow of Plastic Lake south-central Ontario, during the spring of 1982. Using artificial channels allowed the manipulation of pH during a natural pH depression (i.e., spring snowmelt) while minimizing confounding factors such as mobilization of metals from aquatic sediments. Addition of sulfuric acid extended and exaggerated the natural pH depression (from pH 5.8 to 4.8) to as low as pH 3.5 over 5 days, while addition of limestone prevented depression of pH below 6.4. Survival and reproduction of the pisidiid clams Pisidium equilaterale Prime and Pisidium casertanum (Poli) and the hydrobiid snail Amnicola limosa Say held in artificial channels were not significantly different (p > 0.05) among treatments. The survival and reproduction of A. limosa was also not affected by exposure to short-term pH depressions (e.g., 5.8 to 4.8; 4.8 to 4.3) in three south-central Ontario streams during spring snowmelt. For various life stages of both P. equilaterale and A. limosa, 96-h LC50 values were below pH 4.0, which was well below the pH observed in any stream in this study. These results suggest that recruitment failure and elimination of A. limosa from acidifying lakes noted in other studies was not a direct result of short-term pH depression during snowmelt. (Alexander-PTT)

BACTERIAL MUTAGENICITY AND CARCI-NOGENIC POTENTIAL OF SOME AZAPYR-ENE DERIVATIVES, SRI International, Menlo Park, CA. M. J. Tanga, R. M. Miao, and E. J. Reist. Mutation Research MUREAV, Vol. 172, No. 1, p 11-17, October 1986. 2 fig. 2 tab, 15 ref. National Inst. of Environmental Health Science Grant ES03249

Descriptors: "Water pollution effects, "Nitrogen compounds, "Carcinogens, "Mutagens, "Bacteria, "Bioassay, "Toxicity, "Azapyrenes, "Organic compounds, Assay, Salmonella, Survival, Ames test,

Metabolism.

The mutagenic and carcinogenic activities of five azapyrenes, which are suspected of being environmental pollutants, were assessed using the Salmonella assay and the anchorage-independent survival assay. The compounds tested were: 1-azapyrene, 2-azapyrene, 4-azapyrene, 1-aza-2-hydroxypyrene, and 2-aza-1-hydroxypyrene. The compounds were mutagenic and some were also carcinogenic. All of the azapyrenes and the hydroxyl analogs were mutagenic in the Ames test, with only 4-azapyrene and 2-aza-1-hydroxypyrene requiring metabolic activation. In the assay, 2-aza-1-hydroxypyrene was only very weakly mutagenic. Liver S9 increased the number of revertants per plate in all cases, suggesting that the metabolites of the azapyrenes are the ultimate mutagens. Substitution of a hydroxyl group at the C-1 position decreases the activity of 2-azapyrene, while substitution at the C-2 position of 1-azapyrene appears to have no effect. The results of the anchorage-independent survival assay suggests that 2- and 4-azapyrene and 2-aza-1-hydroxypyrene have carcinogenic potential. The assay suggests that 2- and 4-azapyrene and 2-aza-1-hydroxypyrene have carcinogenic potential. The parent compound, pyrene, is not a carcinogen and is inactive in this system. The substitution of the nitrogen moiety in the pyrene ring clearly increases carcinogenic potential. Both 2-azapyrene and 2-aza-1-hydroxypyrene are as potent as DMBA in this system, which suggests that they are potent environmental carcinogens. (Author's abstract) W87-04470

UNRAVELLING A CENTURY OF ACID POL-LUTION, For primary bibliographic entry see Field 5B. W87-04473

Effects Of Pollution-Group 5C

CELLULAR READJUSTMENT OF BARLEY SEEDLINGS TO SIMULATED ACID RAIN, Lancaster Univ., Bailrigg (England). Dept. of Bio-logical Sciences. J. Wolfenden, and A. R. Wellburn. New Phytologist NEPHAV, Vol. 104, No. 1, p 97-109, September 1986. 7 fig, 2 tab, 37 ref.

Descriptors: "Acid rain, "Buffer capacity, "Tissue analysis, "Water pollution effects, "Barley, "Seed-lings, "Acidity, "Plant physiology, "Rainfall, Air pollution, Hydrogen ion concentration, Growth media, Sulfates, Chromatography, Anions, Nuclear magnetic resonance, Spectroscopy, Orthophosates. Growth.

No changes in buffer capacity at any range of pH were detected in either the shoots or roots of nine-day-old barley seedlings grown in dilute acid (pH 3 or 4) for the last four days of growth. Similar lack ony-oit bariey secuning growth in ditute acid prior 4) for the last four days of growth. Similar lack
of change in buffer capacity was observed in
barley intermittently sprayed with acidic mists (pH
3 or 4) as compared to those sprayed with pH 5.6
media for the last two or four days of growth.
Acidic treatments caused significant increases in
the levels of plastidic sulfate, but no changes in the
plastidic concentrations of other anions. Vacuolar
pH levels of those tissues which had been sprayed
with acidic solutions were significantly lower than
in those similarly sprayed with pH 5.6 solutions.
This may mean that ATP-dependent H(+)-pumps
in the tonoplast are involved in cellular readjustments to the imposed acidity. No growth reductions or visible injury were detected, but these
changes may indicate that homeostatic adjustments
have an energetic cost which may ultimately account for reductions in plant growth attributed
elsewhere to acidic precipitation. (Author's abtract)
WELMATA stract) W87-04474

POLLUTED RAIN FALLS IN SPAIN, M. Health. New Scientist NWSCAL, Vol. 111, No. 1526, p 60-62, September 18, 1986.

Descriptors: *Acid rain, *Air pollution, *Air pollution effects, *Spain, *Sulfur dioxide, *Acidity, Weathering, Chemical reactions, Limestone, Sandstone, Gypsum, Calcium carbonate.

The principality of Asturias has Spain's biggest steel works and is the source of most of the country's coal; its industries and towns are sources of atmospheric pollution. The University of Oviedo's Department of Petrology is studying the effects of this pollution on Oviedo Cathedral, where sculptures of limestone and dolomite are deteriorating. Pollution causes buildings to deteriorate by a complex interaction between the rocks used in construction and many environmental factors. The problem varies in severity from stains to weatherprex interaction retween the rocks used in Con-struction and many environmental factors. The problem varies in severity from stains to weather-ing and chemical reaction obliterating important architectural features or weakening building struc-tures. The researchers studying Oviedo Cathedral believe that its stones suffer not only from acid rain but from local pollution, magnified by local envi-ronmental conditions. The main agent of corrosion appears to be suffur dioxide from within the city, deposited by aerosols. Ferric oxide and carbon pollutants may promote corrosion by catalyzing oxidation of the gas. Fog and drizzle help transport the pollutants, and the prevailing winds determine where they will penetrate the rock. Scientists and politicians everywhere must evaluate all the fac-tors involved to adopt successful remedial or pre-ventive measures. (Doria-PTT) ventive meas W87-04478

PROGRAM AND PERFORMANCE CHARACTERISTICS OF THE ENVIRONMENTAL CHAMBERS DURING A LONG-TERM EXPERMENT WITH NORWAY SPRUCE TREES EXPOSED TO OZONE, ACID MIST, AND FROST BESCHREIBUNG DER EXPOSITIONSKAMMERN UND DER VERSUCHSBEDINGUNGEN BEI DER BELASTUNG VON PFLANZEN MIT LUFTSCHADSTOFFEN UND KLIMASTRESS), Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Lehrstuhl fuer Bodenkunde.

For primary bibliographic entry see Field 7B. W87-04488

EFFECTS OF MAGNESIUM AND CALCIUM FERTILIZATION, OZONE AND ACID MIST ON THE MINERAL NUTRITION, FROST RESISTANCE AND BIOMASS PRODUCTION OF YOUNG SPRUCE TREES (PICEA ABIES (L.) KARST) (EINFLIUSS EINER DUBENGUNG MIT MAGNESIUM UND CALCIUM, VON OZON UND SAUREM NEBEL AUF FROSTHAERTE, ERNAEIHRUNGSZUSTAND UND BIOMASS-PRODUKTION JUNGER FICHTEN (PICEA ABIES (L.) KARST)), Munich Univ. (Germany, F.R.). Inst. fuer Systematische Botanik.
C. Bosch, E. Pfannkuch, K. E. Rehfuess, K. H. Runkel, and P. Schramel.
Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 218-229, September 1986. 7 fig, 7 tab, 11 ref.

Descriptors: *Water pollution effects, *Nutrients, *Temperature effects, *Spruce trees, *Ozone, *Prost, *Calcium, *Magnesium, *Plant pathology, *Frost resistance, *Climatic stress, Hydrogen ion concentration, Fertilization, Acid fog, Leaching, Soil types, Accumulation, Shoots.

A frost shock with minimum temperatures down to -18 C. caused the death of nearly all affected trees. Spruces fertilized with MgCa as well as the unfertilized ones were not adequately frost-resistant (down to -15 and -12 C., respectively). Alternate spraying with acid mist and fumigation with ozone increased the leaching of Ca, Mg. Fe, and Mn from shoots of unfertilized spruces significantly. Accelerated leaching, however, went along with foliar deficiency of Mg and Ca only on soils especially poor in exchangeable Mg and Ca. Trees on soils fertilized with both elements were able to compensate for the minor losses in the foliage by additional uptake from the soil. Shoot increment in 1984 and 1985 increased after MgCa fertilization, but was not significantly affected by ozone and acid mist treatment. (Author's abstract) W87-04489

RESPONSE OF THE ROOT SYSTEM OF PICEA ABIES (L.) KARST TO FERTILIZER APPLICATION AND FUMIGATION OF THE SPROUT WITH OZONE AND ACID MIST (REAKTIONEN DES WURZELSYSTEMS VON PICEA ABIES (L.) KARST AUF MINERAL STOFFERNAEHRUNG UND AUF BELASTUNG DES SPROSSES MIT OZON UND SAUREM NEBET)

DES SPROSSES MIT UZUN UND SAUREM NEBEL), Munich Univ. (Germany, F.R.). Inst. fuer Syste-matische Botanik. M. Weiss, and R. Agerer. Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 230-233, September 1986. 1 fig, 9 ref.

Descriptors: "Water pollution effects, "Nutrients, "Acid rain, "Plant disease, "Air pollution effects, "Acid fog, "Spruce trees, "Ozone, "Fertilization, "Plant pathology, "Roots, Bavaria, Magnesium, Calcium, Forests, Environmental stress, Biomass.

The root system of four-year-old cuttings of Picea Abies (L.) Karst was investigated as to its response to mineral nutrition and to application of ozone and acid mist to the sprout. The study aims to acquire more broadly applicable data on environmental stress to young spruces. Lack of Ca and Mg fertilization resulted in reduced development of the root system with an evidently lower biomass of fine roots, a lower infestation with Pemphigidae, and fungal infection within the vascular bundle. Treatment with ozone brought about a slightly lower fine-root biomass. These results were, however, not statistically significant. No effects could be found as a result of application of acid fog. All mycorrhizae found originated in the nursery. Soil from the Bavarian Forest, used as planting substrate, did not cause mycorrhizal infections. (Airone-PTT)

EFFECTS OF OZONE AND ACID MIST ON THE EPICUTICULAR WAX IN THE STOMA-

TAL ANTECHAMBER OF NEEDLES OF PICEA ABIES (L.) KARST (EINFILUSS VON OZON UND SAUREM NEBEL AUF DIE STRUKTUR DER STOMATAEREN WACHSF-FROPFEN IN DEN NADELN VON PICEA

FROPFEN IN DEN NADELN VON PICEA ABIES (I.) KARST), Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Botanik. E. Magel, and H. Ziegler. Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 234-238, September 1986. 1 fig. 14 ref.

Descriptors: *Spruce trees, *Picea Abies (L) Karsi, *Ozone, *Forests, *Water pollution effects, *Acid rain, *Air pollution effects, *Acid fog, *Plant pathology, *Environmental stress, Wax plugs, Pine needles, Stomata, Microscopy.

In contrast to current-year needles, one- and two-year-old needles polluted by ozone and/or acid mist showed no remarkable differences of the structural waxes occluding the stomatal antechamstructural waxes occluding the stomatal antechamber. Wax plug formation in current-year needles, however, was severely disturbed by different stress conditions. Structural wax outlining the stomatal openings of clean-air needles exhibit fused wax rodlets after ozone fumigation. Cracks were built up in wax plugs of acid-mist-treated spruce needles. Ozone and acid mist in combination caused fusion of wax rodlets and cracks in the wax-filled antechamber. The described changes due to fumigation can be observed in both fertilized and unfertuilized plants. The data were obtained via electron microscope examination of prepared, dried needles. The needles were obtained from five-year-old cloned spruces exposed to different experimental cloned spruces exposed to different experimental conditions during the period February-June 1985. (Airone-PTT) W87-04491

INFLUENCE OF MINERAL NUTRITION, OZONE, AND ACID MIST ON PHOTOSYN-THETIC PARAMETERS AND STOMATAL CONDUCTANCE OF PICEA ABIES (L.) KARST CEINFLUSS VON MINERALSTOFFERNAEH-RUNG, OZON UND SAUREM NEBEL AUF PHOTOSYNTHESE-PARAMETER UND STOMATAERE LEITFAEHIGKEIT VON PICES ABIEA (L.) KARST), Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl fuer Physik. H. Selinger, D. Knoppik, and A. Ziegler-Joens. Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 239-242, September 1986. 2 fig. 1 tab, 6 ref.

Descriptors: *Spruce trees, *Nutrients, *Acid rain, *Water pollution effects, *Ozone, *Acid fog, *Forests, *Fertilization, *Bavaria, Calcium, Magnesium, Photosynthesis, Carbon dioxide, Plant pathology, Biomass, Productivity, Light effects.

Biomass, Productivity, Light effects.

CO2 response and light response of CO2 uptake and H2O release give a quantitative measure for physiological changes due to pollutants and to different mineral nutrition, and allow evaluation of these plants biomass production potential. Photosynthetic parameters and stomatal regulation were found to be affected by pollutants depending on the nutritional status. In all plants, which were polluted with ozone and which were not fertilized, maximum carboxylation capacity, maximum net photosynthesis rate (at saturating light and CO2 partial pressure), apparent quantum yield, and regulation ability of the stomata were considerably reduced. The light compensation point and the CO2 compensation point are considerably enhanced. After MgCa fertilization, increased photosynthetic capacity was observed. These results, in particular the analysis of the photosynthetic and stomatal behavior, support the hypothesis that forest decline in the high altitudes of the Bavarian Forest is caused by a combination of ozone pollution and acid deposition from the atmosphere, particularly with magnesium deficiency. Injuries by ozone alone, however, are more pronounced than injuries by acid mist alone. (Author's abstract) W87-04492

EFFECT OF MINERAL NUTRITION, OZONE AND ACID MIST ON THE CONTENTS OF ADENINENUCLEOTIDES, INORGANIC

Group 5C-Effects Of Pollution

PHOSPHATE AND CARBOHYDRATES IN NEEDLES OF PICEA ABIES (L.) KARST (EIN-FLUSS VON MINERALSTOFFERNAEHRUNG, OZON UND SAUREM NEBEL AUF DEN GEHALT AN ADENINNUCLEOTIDEN, ANOR-GANISCHEM PHOSPHAT UND KOHLENHY-DRATEN IN NADELN VON PICEA ABIES (L.) KARST. KARST),

e Univ. Muenchen (Germany, F.R.).

Lehrstuhl fuer Botanik.

E. Magel, and H. Ziegler.
Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 243-251, September 1986. 3 fig. 3 tab, 23 ref.
Europaische Wirtschaftsgemeinschaft Grant ENV-

Descriptors: "Water pollution effects, "Nutrients, "Acid rain, "Air pollution effects, "Plant physiology, "Acid fog, "Air pollution, "Spruce trees, "Picea Abies (L) Karst, "Ozone, "Fertilization, Energy charge, Pine needles, Adenine, Phosphates, Carbohydrates, Magnesium, Calcium, Tissue analysis.

The effect of air pollutants and acid fog on the adenyiate and carbohydrate content of pine needles was analyzed. Spruce needles kept under different stress conditions showed in many cases dies was analyzed. Spruce needles kept under different stress conditions showed in many cases
higher ATP concentrations, higher ATP/ADP
ratios and higher energy charge values, compared
with non-stressed control plants. This is most pronounced in current-year needles. Phosphorylation
potential showed the following pattern: currentyear needles of fertilized plants exhibited lower
values after stress, the one- and two-year-old needles showed increased values while in all needles
of the unfertilized plants higher values were measured. Current-year needles under stress exhibited
higher glucose and fructose concentrations in comparison with the courtor while succose and starch parison with the control while sucrose and starch levels were lowered. The carbohydrate concentrawere sowered. The carbohydrate concentra-tions in control trees were more or less the same in needles of all ages. The experimental needles were from five-year-old cloned spruce trees exposed to varying conditions during February to June 1985. (Airone-PTT) W87-04493

EFFECT OF MINERAL NUTRITION, OZONE AND ACID MIST ON PEROXIDASE ACTIVITY IN NEEDLES OF NORWAY SPRUCE, PICEA ABIES (L) KARST (EINFLUSS VON MINER-ALSTOFFERNAEHRUNG, OZON UND SAUREM NEBEL AUF PEROXIDASE-AKTIVI-TAETEN IN FICHTENNADELN, PICEA ARIES

(L.) KARST),
Gesellschaft fuer Strahlen- und Umweltforschung
m.b.H. Muenchen, Neuherberg (Germany, F.R.).
Inst. fuer Toxikologie und Biochemie.

Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 252-254, September 1986. 1 tab, 8 ref.

Descriptors: *Water pollution effects, *Nutrients, *Plant physiology, *Acid rain, *Air pollution effects, *Spruce trees, *Ozone, *Acid fog, *Air pollution, *Bioindicators, *Fertilization, Peroxidase, Enzy

As part of the first experiment of MAGL (Munich working group on air pollutants), peroxidase activity was investigated in spruce needles treated with ozone, acid mist, and differential Ca and Mg nutrition. (Peroxidase has been used as an indicator system for environmental stress due to air pollutants.) The enzyme shows decreases, increases, or undifferentiated response depending on needle age and treatment. POD in needles from 1984 generally decreased with corpus and/or acid mist treatment. and treatment. POD in needles from 1984 generally decreased with ozone and/or acid mist treatment. Needles from 1983 showed reduced activity after the ozone treatment as well. Acid mist, however, caused an increase in POD activity in 1983 needles, but there was no influence on POD in 1985 needles due to acid mist. Fertilization of the soil with Ca and Mg entails bigher POD in needles of those plants which were kept within the chambers whereas fertilization of comparable plants kept in the field brings about a decrease in POD activity. The enzyme responds to many different factors, and these responses are very heterogeneous. Hence, measurement of the activity of the total soluble peroxidases is not considered a useful

bioindication system for air pollutants. (Author's

INFLUENCE OF MINERAL NUTRITION, OZONE AND ACID FOG ON ABSCISIC ACID AND INDOLE ACETIC ACID IN NEEDLES OF PICEA ABIES (L.) KARST (EINFLUSS VON MINERALSTOFFERNAEHRUNG, OZON UND SAUREM NEBEL AUF INDOLESSIGSAEURE UND ABSCISINSAEURE IN NADELN VON

UND ABSCISINSAEURE IN NADELN VON PICEA ABIES (L.) KARST), Gesellschaft fuer Strahlen- und Umweitforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). U. Fackler, W. Huber, and B. Hock. Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 254-257, September 1986. 2 fig, 8 ref. Bayerisches Staatsministerium fuer Landesentwicklung und Umweitfragen Grant 6495-653-33592 and Deutsche Forschungsgemeinschaft Grant Ho 383/21.2.

Descriptors: *Water pollution effects, *Plant physiology, *Tissue analysis, *Acid rain, *Air pollution effects, *Spruce trees, *Ozone, *Fertilization, *Acid fog, *Abecisic acid, *Auxin, *Plant growth substances, Indoleacetic acid.

The phytohormones abscisic acid (ABA) and auxin (IAA = total, free, and alkali-labile IAA) were quantified in needles from spruces which had been exposed to air pollutants under different controlled (IAA = totals, note, such a quantified in needles from spruces which had been exposed to air pollutants under different controlled climatic conditions within the MAGL pilot project (five-year-old cloned spruces maintained within environmental chambers newly installed by MAGL, the project of the property of the property of the project the Munich working group on air pollutants). In-creased concentrations of ABA were found, espe-cially in the most recent needles after ozone treatment. Noticeable changes in auxin concentrations were not observed. These results should be backed up by further experiments with more samples in order to gain insight into the hormonal balance of plants under stress by air pollution. (Airone-PTT) W87-04495

INFLUENCE OF MINERAL NUTRITION, OZONE, AND ACID MIST ON THE CONTENT OF THE FUNGITOXIC COMPOUND P-HY-OF THE FUNGITOXIC COMPOUND P-HYDROXYACETOPHENONE IN SPRUCE NEEDLES (PICEA ABIES (L.) KARST) (EINFLUSS
VON MINERALSTOPFERNAEHRUNG, OZON
UND SAUREM NEBEL AUF DEN GEHALT
DER FUNGITOXISCHEN SUBSTANZ P-HYDELN (PICEA ABIES (L.) KARST)),
Technische Liniv, Muenchen (Germany, F.R.)

DELN (PICEA ABRES (L.) KARST), Technische Univ. Muenchen (Germany, F.R.). Inst. fuer Botanik und Microbiologie. W. F. Osswald, H. Heinisch, and E. F. Elstner. Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 261-264, September 1986. 1 tab, 9 ref.

Descriptors: *Spruce trees, *Water pollution effects, *Nutrients, *Tissue analysis, *Plant physiology, *Acid rain, *Air pollution effects, *Ozone, *Fertilization, *Acid fog, *Fungitoxins, *Hydroxyacetophenone, Pine needles, Plant protection.

concentration of the fungitoxic compou HAP (p-hydroxyacetophenone) of one- and two-years-old spruce needles is decreased with respect to control needles after treatment with ozone. Fer-tilizing with Ca or Mg has a positive effect on the p-HAP content of spruce needles. (Author's ab-

CONTENTS OF CHLOROPHYLL AND THE ANTIOXIDANTS ASCORBIC ACID, GLUTATHION AND TOCOPHEROL IN SPRUCE NEEDLES (PICEA ABIES (L.) KARST) AS A FUNCTION OF MINERAL NUTRITION, OZONE, AND ACID MIST GEHALTE AN CHLOROPHYLL UND DEN ANTIOXIDANTIEN ASCORBAT, GLUTATHION UND TOCOPHEROL IN FICHTENNADELN (PICEA ABIES (L.) KARST) IN ABHAENGIGKEIT VON MINERALSTOFFERNAEHRUNG, OZON UND SALIPEM NEFREL)

SAUREM NEBELJ,
Gesellschaft fuer Strahlen- und Umweltforschung
m.b.H. Muenchen, Neuherberg (Germany, F.R.).

Inst. fuer Toxikologie und Biochemie. H. Senger, W. Osswald, M. Senser, H. Greim, and E. F. Elstner. Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 264-267, September 1986. 1 tab, 7 ref.

Descriptors: *Spruce trees, *Water pollution effects, *Nutrients, *Plant physiology, *Tissue analysis, *Acid rain, *Air pollution effects, *Antioxidatis, *Ozone, *Fertilization, *Acid fog, *Ascorbic acid, *Glutathion, Tocopherol, Pine needles, Chlorophyll.

Spruce needles of the needle age classes 1983 and 1984, subjected to various pollutants, were analyzed for chlorophyll, ascorbic acid, glutathion and tocopherol content. Based on the results, which must be verified by further experiments, it may be concluded that the tocopherol content increases with either ozone or acid fog treatment, and decreases when both stresses are combined. Glutathion levels decrease after acid mist treatment and increase after ozone treatment. The fluctuations in the levels of ascorbate are within natural variation. There is no indication of the effects of treatment on chlorophyll content. (Author's abstract) stract) W87-04498

INVESTIGATIONS ABOUT THE EFFECTS OF ACID DEPOSITION AND COMPENSATIVE LIMING IN THE FOREST OBJECTIVES INSTALLATION AND HITHERFO REALIZATION OF THE FIELD EXPERIMENT HOEGLWALD INCLUSIVE ACCOMPANYING INVESTIGATIONS UTERSUCHUNCEN UEBER DIE AUSWIRKUNGEN DES SAUREN REGENS UND DER KOMPENSATORISCHEN KALKUNG IM WALD ZIELSETZUNG, ANLAGE UND BISHERIGE DURCHPUEHRUNG DES FREILANDSEXPERIMENTS HOEGLWALD EINSCHLESSLICH BEGLEITENDER UNTERSUCHUNGEN,

SUCHUNGEN),
Technische Univ. Muenchen (Germany, F.R.).
Lehrstuhl fuer Bodenkunde.
K. Kreutzer, and I. Bittersohl.
Forstwissenschaftliches Centralblatt, Vol. 105, No.
4, p 273-282, September 1986. 2 fig, 4 tab, 22 ref.

Descriptors: *Water pollution effects, *Comparison studies, *Irrigation, Acid precipitation, *Air pollution effects, Spruce trees, *Bavaria, *Liming, *Forests, *Acid rain, Bavaria, Dolomite, Sulfuric

A field experiment was installed to investigate the effects of intensified artificial acid deposition and compensative liming on stand, soil, and seepage water of a forest ecosystem. The main experimental unit is a large soil irrigation installation in an old spruce stand. This is complemented by a methodically equivalent experiment with irrigation above the canopy in a young spruce stand. Comparable investigations without experimental treatment are carried out in a number of distinct stands to examine the influence of sites and stocking types ment are carried out in a number of distinct stands to examine the influence of sites and stocking types on the ecosystem processes under different stress conditions. The irrigation experiments are carried out in the Hoeglwald management unit of the Bavarian forest district of Aichach near Augsburg. The healthy, well growing stands are 79 and 14 H2SO4, pH 2.7-2.8, plots A2, B2, and C2 are limed with 4400 kg dolomite/ha. After two seasons of acid irrigation the input of protons amounts to 6.7 kmol/ha in the old spruce stand and 4.7 kmol/ha in the younger stand. Essential chemical and physical parameters are measured in precipitation, irrigation water, soil, soil solution, and seepage. Water movement in the soil is calculated from the data of a computer controlled tensiometer installation. Furcomputer controlled tensiometer installation. Further special investgations were carried out by numerous research groups. The contributions following this paper as Nr. 2-18 of the Hoeglwald Series 1986 present basic data and first results of the investigations. (Author's abstract)

EFFECTS OF ACID IRRIGATION AND LIMING ON EXCHANGEABLE AND SOLUBLE IONS IN THE SOIL (EINFLUSS VON

Effects Of Pollution—Group 5C

SAURER BEREGNUNG UND KALKUNG AUF AUSTAUSCHBARE UND GELOESTE IONEN

MBODEND, Niv. Muenchen (Germany, F.R.). Lehrstuhl fuer Bodenkunde. For primary bibliographic entry see Field 2G. W87-04501

INFLUENCE OF ACID IRRIGATION AND LIMING ON HUMIC SUBSTANCES AND ON THE DYNAMICS OF ALUMINUM AND HEAVY METAL IONS IN AQUEOUS SOIL EXTRACTS (EINFLUSS VON SAURER BEREGNUNG UND KALKUNG AUF HUMUSTOFFE SOWIE DIE ALUMINIUM- UND SCHWEEMETALLDYNAMIK IN WAESSRIGEN BODENEXTRAFTEN

TRAKTEN), Munich Univ. (Germany, F.R.). Lehrstuhl fuer Bodenkunde.

ary bibliographic entry see Field 2G.

EFFECT OF ACID IRRIGATION AND LIMING ON THE MICROBIAL ACTIVITY OF THE SOIL (DIE AUSWIRKUNGEN VON SAURER BEREGNUNG UND KALKUNG AUF DIE MIK-

BEREGNUNG UND KALEAUNG AUF DIE MIR-ROBIELLE AKTIVITAET IM BODEN), Technische Univ. Muenchen (Germany, F.R.). Lehrstuhl füer Bodenkunde. K. Kreutzer, and L. Zelles. Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 314-317, September 1986. 1 fig, 1 tab, 15 ref.

Descriptors: *Water pollution effects, *Irrigation, *Microbial studies, *Soil horizons, *Acid rain, *Air pollution effects, *Liming, *Soil bacteria, *Microcalorimetric method, Glucose, Adenine triphosphate, Transpiration, Bavaria, Biolumines-

The microcalorimetric technique with added glu-cose has proved well-suited for determining bioac-tivity in the humus layer of an older spruce stand after acid irrigation and liming. Compared with normally-irrigated plots, artificial acid rain with pH 2.7 to 3.0 reduced bioactivity to between 30% pH 2.7 to 3.0 reduced bioactivity to between 30% and 50% of that under conditions of normal rain. Liming about doubled bioactivity, but significantly only in distinct subhorizons (Of12 and Of2). These subhorizons are characterized by a lime induced pH increase as well as by better microclimatic conditions than those prevailing in subhorizon Of11 (above the two). Possibly, the easily decomposible compounds were already used up in the more directly affected Of11. (Liming took place in April 1985, sampling was in September of the same year. Samples were also measured for soil respiration and for ATP content, this last via bioluminescence). (Airone-PTI) cence). (Airone-PTT) W87-04503

NUTRIENT ELEMENT CONTENTS IN THE FINE ROOTS OF SPRUCE FOLLOWING LIMING AND ACID IRRIGATION (NAEHR-ELEMENTGEHALTE IN DEN FEINWURZELN DER FICHTE NACH SAURER BEREGNUNG UND KALKUNG),

Bundesforschungsanstalt fuer Forst- und Holz-wirtschaft, Hamburg (Germany, F.R.). Inst. fuer Holzchemie und Chemische Technologie des

Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 321-324, September 1986. 1 tab, 8 ref.

Descriptors: *Liming, *Roots, *Nutrients, *Spruce trees, *Acid pollution effects, *Water pollution effects, *Irrigation, *Bioaccumulation, *Soil horizons, *Acid rain, Bavaria, Iron, Magnesium, Alu-

Within one year, liming caused increased uptake of aluminum and iron. At the same time, uptake of magnesium and calcium in the roots likewise increased. Acid irrigation led to a decrease of magnesium in fine roots growing in the humus layer, and it increased the iron concentration in roots (possibly due to an enhanced mobilization of soil iron). The other elements reacted differently. Four different soil treatments were involved in this

study: liming only, acid irrigation only, both liming and acid irrigation, and an unaltered control. Sam-ples were from two horizons, the Oh/Ah transition region and the Al horizon. (Airone-PTT)

EFFECT OF ARTIFICIAL ACID RAIN ON THE DEVELOPMENT OF FINE-ROOTS AND MY-CORRHIZAE OF NORWAY SPRUCE (EIN-FLUSS VON SAURER BEREGNUNG UND KALKUNG AUF DIE BIOMASSE UND MY-CORRHIZIERUNG DER FEINWURZELN VON

Munich Univ. (Germany, F.R.). Lehrstuhl fuer Forstbotanik.

Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 324-329, September 1986. 3 fig, 3 tab, 17 ref. BML Project -83 HS 013.

Descriptors: "Simulated rainfall, "Acid rain, "Air pollution effects "Water pollution effects, "Plant physiology, "Liming, "Spruce trees, "Root development, "Bioindicators, "Mycorrhizae, Bavaria, Roots, Ingrowth method.

As part of an interdisciplinary acid rain experiment, the development of fine roots including mycorrhizae was investigated on plots by soil core sampling during 2 growing seasons in a 72-year-old Norway spruce stand at Hoeglwald in Bavaria. Higher numbers of necrotic short roots were found to be a sensitive indicator reflecting the influence of irrigation with acid water. In addition, root regeneration and mycorrhiza formation were evaluated using the ingrowth method with either sand or vermiculite as rooting medium. With the above approach minor differences between normal irrigation and the control plot were observed in the abundance of both ectomycorrhizal and non-mycorrhizal short roots. With the acid rain treatment the number of mycorrhizal and non-mycorrhizal root tips decreased markedly. (Author's abstract) W87-04505

CHARACTERIZATION AND INVENTORY OF ECTOMYCORRHIZAE ON SPRUCE IN THE HOEGLWALD AND THEIR REACTION TO ACID PRECIPITATION (CHARAKTERISIER-UNG UND INVENTUR DER FICHTEN-MY-CORRHIZEN IM HOEGLWALD UND DEREN REAKTIONEN AUF SAURE BEREGNUNG), Munich Univ. (Germany, F.R.). Inst. fuer Systematische Botanik.

mausche Botanik.
E. Gronbach, and R. Agerer.
Forstwissenschaftliches Centralblatt, Vol. 105, No.
4, p 329-335, September 1986. 2 fig., 6 ref. Bundesministerium fuer Forschung und Technologie AZ
03 7381 4.

Descriptors: *Water pollution effects, *Irrigatio *Surveys, *Air pollution effects, *Ectomycorrizae, *Spruce trees, *Acid rain, Piceirhiza gelatioss, Fluorescence.

A short account is given of some results regarding research on ecto-mycorrhizae in connection with the Hoeglwald project. One frequently occurring mycorrhiza on a plot irrigated with acid water (Piceithiza gelatinosa) is described comprehensively, including microscopic examination, color reactions, and fluorescence results. In addition, an ideation, and fluorescence results. In addition, an ideation, and fluorescence results. ly, including microscopic examination, color reactions, and fluorescence results. In addition, an identification key for some ectomycorrhizae occurring in spruce is proposed. (Airone-PTT)

EFFECT OF SIMULATED ACID RAIN AND LIMING ON NEMATODES (EINFLUSS DER SAUREN BEREGNUNG UND KALKUNG AUF DIE NEMATODENFAUNA), Munich Univ. (Germany, F.R.). Zoologisches Inst.

Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 335-337, September 1986. 2 tab.

Descriptors: *Water pollution effects, *Population density, *Simulated rainfall, *Air pollution effects, *Spruce trees, *Liming, *Nematodes, *Acid rain, Tylenches

As part of the Hoeglwald experiment the effect of simulated acid rain and liming on nematodes was investigated. In the first year (1984) of treatments and investigations, nematodes seemed to increase after liming, irrigation with normal water or liming + irrigation with normal water. On the plot irrigated with acid rain, the number of nematodes, especially of the genus Tylenchus, decreased. Investigations one year later (1985), however, did not confirm these results. Further investigations are planned for 1986 and following years. The samples were obtained from six different surface areas in the older spruce stand examined in the Hoeglwald experiment. The nematodes encountered were of two types: saprophagous and robbertype. (Airone-PTT)

EFFECTS OF EXPERIMENTAL ACID PRE-CIPITATION AND LIMING ON VIGOR, SPE-CIES ABUNDANCE, AND MINERAL NUTRI-TION OF GROUND VEGETATION IN A NORWAY SPRUCE STAND (AUSWIRENINGEN VON SAURER BEREGNUNG UND KALKUNG AUF DIE VITALITAET, ARTENMAECHTIG-KEIT UND NAEHRSTOFFVERSORGUNG DER BODENVEGETATION EINES FICHTENBES-TANDES).

TANDES), Munich Univ. (Germany, F.R.). Lehrstuhl fuer

H. Rodenkirchen. Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 338-350, September 1986. 2 fig, 9 tab, 35 ref.

Descriptors: *Water pollution effects, *Simulated rainfall, *Species composition, *Tissue analysis, *Acid rain, *Nutrients, *Air pollution effects, *Spruce trees, *Liming, *Bavaria, *Oxalis acetosella, Mosses, Forests, Bioaccumulation, Plant growth, Roots.

growth, Roots.

The effects of simulated sulfuric acid rain and liming on ground vegetation of a 75-year-old Norway Spruce stand were analyzed beginning with the summer of 1983. During the first two growing seasons no significant change in species composition occurred. The frequently applied acid rain injured some constant mosses (chlorosis, necroses, reduced average coverage or frequency). Damaged moss segments contained decreased concentrations of Ca, Mg, Mn, Zn, and K. Some secondary moss species were more tolerant to acid rain. Liming (dolomite) at the start of the experiment improved the Ca and Mg nutrition of all investigated species (Thuidium tamariscinum, Ozalis acetosella, spruce seedlings), lowered the intensity of injury by acid rain among mosses, and reduced the Mn and Zn uptake of the vascular plant species. Combination of liming with triagition by acid or 'normal' water strongly increased the abundance of Oxalis acetosella. Without liming the response of this species to acid rain was response of this species to acid rain was reduced this content of Cs and Mg but no visible. the abundance of Oxalis acetosella. Without liming the response of this species to acid rain was reduced foliar content of Ca and Mg, but no visible leaf damage occurred. The analysis of plant tissue, coupled with an understanding of different root extents, and of the specific growth and nourishment physiologies of various species, can contribute to the identification of chemical changes in soil and rain. (Airone-PTT) W87-04508

FOLIAR LEACHING FROM A SPRUCE CANOPY (PICEA ABIES (L.) KARST) BY ACID IRRIGATION (STOFFAUSWASCHUNG AUS FICHTENERONEN (PICEA ABIES (L.) KARST) DURCH SAURE BEREGNUNG), ich Univ. (Germany, F.R.). Lehrstuhl fuer

K. Kreutzer, and J. Bittersohl. Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 357-363, September 1986. 4 tab, 18 ref.

Descriptors: *Water pollution effects, *Leaching, *Canopy, *Irrigation, *Spruce trees, *Acid rain, *Nutrients, Cations, Sulfates, Leaves.

Acid irrigations (H2SO4, pH 2.72), applied 18 times from June to October 1985, caused a 6-7 times larger loss of manganese and calcium, one of magnesium 4-5 times larger, and a doubling of potassium and ammonium loss when compared

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with normal irrigations (pH 5.2). Sulfate was re-tained only for a short time, whereas the retention of H(+) was considerably longer, supposedly caused by a replacement process of bases. Regard-ing magnesium, it seems that Mg fertilization of Mg-poor locations may be effective in curtailing damage in its early stages although measures. damage in its early stages, although such measures are insufficient in the face of damage involving the cuticula or the cell membranes. (Airone-PTT) W87-04509

SYNOPTICAL DISCUSSION OF RESULTS OF FIELD EXPERIMENTS ON THE INFLUENCE OF ACID DEPOSITION AND LIMING IN STANDS OF NORWAY SPRUCE (PICEA ABIES (L) KARST (ZUSAMMENFASSENDE DISKUS-SION DER ERGEBNISSE AUS EXPERIMEN-TELLEN FREILAND-UNTERSUCHUNGEN UEBER DEN EINFLUSS VON SAUREN NIE-DERSCHLAEGEN UND KALKUNG IN FICH-TENBESTAENDEN (PICEA ABIES (L.)

KARST), Munich Univ. (Germany, F.R.). Lehrstuhl fuer Bodenkunde. K. Kreutzer.

Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 371-379, September 1986. 19 ref.

Descriptors: *Water pollution effects, *Field tests, Frigation, "Heavy metals, "Acid reats," Pried tests, "Fried tests, "Frigation," Heavy metals, "Acid rain, "Air pollution effects, "Spruce trees, "Liming, "Plant pathology, "Hoeglwald, Soil chemistry, Cations, Aluminum, Copper, Lead, Metal complexes, Soil hori-

This article discusses the results presented in the preceding articles of the series. Field investigations of a Norway spruce ecosystem are under way to find out what extent intensified acid depositions lead to disturbances in the ecosystem. Additional acid input of 6.7 kmol/ha over a 2-year period did not cause essential damage to the stand, but to ground vegetation and microorganisms. Definite indications of injuries caused by aluminum or heavy metal mobilization could not, however, be found thus far. Beneath the Ach horizon the prevailing part of aluminum occurs as monomer, but the mucigel of the root tip seems to be an efficient the mucigel of the root tip seems to be an efficient protection against aluminum poisoning despite the intensified acid deposition. Soil alkalization (4000 kg dolomite/ha) is progressing only slowly with depth via bicarbonate transfer. In neutral or alkaline horizons, microorganisms and depth via bicarbonate transfer. In neutral or alkaline horizons, microorganisms and prevailing groundcover plants, such as oxalis, are significantly stimulated. Very remarkable is the increase of dissolved organic compounds leading to a marked mobilization of organic lead and copper complexes. Liming combined with acid irrigation causes intensified dissolution of dolomite and an initially accelerating deacidification. Microorganisms and oxalis suffer from this acid input despite the high pH of the substrate they inhabit. (Airone-PTT) W87-04511

USE OF FRESHLY PREPARED RAT HEPATO-CYTES TO STUDY TOXICITY OF BLOOMS OF THE BLUE-GREEN ALGAE MICROCYSTIS AERUGINOSA AND OSCILLATORIA AGARD-

Norges Veterinaerhoegskole, Oslo. Dept. of Food Hygiene. T. Aune, and K. Berg. Journal of Toxicology and Environmental Health, JTEHD6, Vol. 19, No. 3, p 325-336, 1986. 4 fig, 3 tab, 12 ref.

Descriptors: "Hepatocytes, "Cyanophyta, "Bioasay, "Toxicity, "Water pollution effects, "Lakes, "Algae, Norway, Enzyme, Cell morphology, Food

Extracts from blue-green algal blooms from different lakes in southeastern Norway were tested for toxicity toward freshly prepared rat hepatocytes. The toxicity effects were scored by means of morphological studies of the cells and by means of morphological studies of the cells and by measuring leakage of the enzyme lactate dehydrogenase (LDH) from the cells. The results with the hepatocytes correspond well with results from the traditional mouse bioassay, concerning both ability to distinguish between toxic and nontoxic samples

and estimation of relative toxicity. Morphological changes due to toxic effects on the plasma membrane appeared earlier than leakage of enzyme from damaged cells. The results indicate that the hepatocyte-toxicity assay system might be well suited for screening purposes concerning water for screening purposes concerning water ination by blue-green algae. (Author's ab-

ASSOCIATION BETWEEN PCBS AND LOWER EMBRYONIC WEIGHT IN BLACK-CROWNED NIGHT HERONS IN SAN FRANCISCO BAY, Patuxent Wildlife Research Center, Laurel, MD. D. J. Hoffman, B. A. Rattner, C. M. Bunck, A. Krynitsky, and H. M. Ohlendorf. Journal of Toxicology and Environmental Health JTEHD6, Vol. 19, No. 3, p 383-391, November 1986. 1 fig, 2 tab, 31 ref.

Descriptors: *Embryonic growth, *Water pollution effects, *Reproduction, *Waterfowl, *San Francisco Bay, *Polychlorinatedbijhenyls, Herons, Eggs, Gas-liquid chromatography, Mass spectrometry, Tissue. Brzymes, Organic compouns, Tissue.

Reproductive problems, have been observed in colonial-nesting water birds at the San Francisco Bay National Wildlife Refuge (SFBNWR). Twenty-four black-crowned night heron eggs were collected from SFBNWR in 1983. Twelve of these were collected from SFBNWR in 1983. these were collected from separate nests when these were collected from separate nests when late-stage embryos were pipping, and an additional egg-was randomly collected from each nest for organ-ochlorine analysis. Overt anomalies and skeletal defects were not apparent. Embryonic weights were 15% lower in SFBNWR embryos compared to control embryos from the Patuxent Wildlife Research Center (PWRC). Crown-rump length and femur length were shorter for SFBNWR em-bryos. The segmentric mean PCB concentration in and femur length were shorter for SFBNWR embryos. The geometric mean PCB concentration in SFBNWR eggs was 4.1 ppm wet weight, with a range of 0.8-52.0 ppm. A negative correlation existed between embryonic weight and log-transformed PCB residues in whole eggs collected from the same nest at SFBNWR, suggesting a possible impact of PCBs on embryonic growth. A correlation with embryonic weight did not occur for DDE residues. Liver microsomal aryl hydrocarbon hydroxylase activity was neither significantly elevated nor correlated with PCB, DDE, or PCB plus DDE log-transformed residues. It is unknown whether the apparent association between PCBs and lower weight is persistent through hatching. (Main-PTT) W87-04537

EVALUATION OF THE SIGNIFICANCE OF METAL-BINDING PROTEINS IN THE GASTROPOD LITTORINA LITTOREA, Marine Biological Association of the United Kingdom, Plymouth (England).
W. J. Langston and, and M. J. Zhou.
Marine Biology, MBIOAJ, Vol. 92, No. 4, p 505-515, September 1986. 6 fig. 5 tab, 23 ref, Department of the Environment contract no. DGR 480/51.

Descriptors: "Fate of pollutants, "Water pollution effects, "Population exposure, "Bioassay, "Heavy metals, "Bioaccumulation, "Metal-binding proteins, "Littorina, Zinc, Cadmium, Silver, Mercury, Gel chromatography, Tissue ayalysis, Atomic absorption spectrophotometry.

The subcellular distribution of cadmium and other metals in Littorina littorea from clean and contaminated field sites and in individulas exposed to cadmium in the laboratory was investigated. Metal binding in relation to the use of L. littorea as a monitoring organism for metal pollution was also evaluated. Littorina were subjected to various concentrations of Cd. After exposure, winkles were pooled and homogenised and samples were subjected to gel chromatography. Other homogenate samples were dried and digested with HNO3 for analysis of Ag. Cd, Cu, and Zn by either flame or graphite-furnace a tomic absorption. Hg in freshaphite-furnace atomic absorption. Hg in fresh-sue homogenates was determined by cold-pour atomic absorption spectrophotometry.

Body concentrations of Ag, Cd, and Hg varied according to environmental contamination, while the essential elements Cu and Zn were regulated. In contrast to Ag and Hg, which were mainly associated with high molecular weight ligands, Cd was bound predominantly to an intermediate molecular weight, soluble protein (CdBP-I). Laboratory experiments confirmed the role of CdBP-I in complexing Cd, and revealed the induction of a second Cd-binding protein (CdBP-II) in response to high Cd levels. A dose-related increase in the SH content of very low molecular weight fractions was observed in Cd-exposed L. Littorea. A detoxifying role is tentatively proposed for the metal binding proteins CdBP-I and II in L. littorea. (Author's abstract)

NEW METHOD FOR DETECTING POLLU-TION EFFECTS ON MARINE MACRO-BENTHIC COMMUNITIES,

Institute for Marine Environmental Research, Plymouth (England).

Plymouth (Engiand).
R. M. Warwick.
Marine Biology MBIOAJ, Vol. 92, No. 4, p 557562, September 1986. 4 fig. 18 ref. Department of
the Environment (England) Contract PECD 7/7/

Descriptors: *Water pollution effects, *Mathematical models, *Macrobenthos, *Marine environment, Pulp-mill effluent, Sediment, Species diversity, Princepage

A method is described by which the pollution status of a marine macrobenthic community may be assessed without reference to a temporal or spatial series of control samples. Theoretical considerations suggest that the distribution of numbers of individuals among species should behave differently from the distribution of biomass among species when influenced by pollution-induced disturbance. Combined k-dominance plots for species biomase. cies when influenced by pollution-induced disturb-ance. Combined k-dominance plots for species bio-masss and numbers take three possible forms repre-senting unpolluted, moderately polluted and gross-plated conditions, one curve acting as an internal control against which the other can be compared. Field data from unpolluted communi-ties and from a well documented temporal pollu-tion gradient support the model, but further empir-ical testing is required. (Author's abstract) W87-04539

CLEARCUITING AND THE BIOGEOCHE-MISTRY OF STREAMWATER IN NEW ENG-

Northeastern Forest Experiment Station, Durham, NH.

NH. C. W. Martin, D. S. Noel, and C. A. Federer. Journal of Forestry, Vol. 83, No. 11, p 686-689, November 1985. 1 fig, 4 tab, 24 ref.

Descriptors: *Clear-cutting, *Streams, *New England, Nutrients, Nitrates, Nitrogen, Calcium, Potassium, New Hampshire, Insects, Temperature, Algae, Organic matter, Stream pollution.

A survey showed that clearcutting in New England may increase stream nutrients, including nitrate-nitrogen, calcium and potassium. The largest increases were found in northern hardwoods in increases were found in northern hardwoods in New Hampshire. Stream insect populations, particularly mayflies and tru flies, increased in clear cuts in response to increased stream temperature, algal populations and organic matter. Changes in streamwater chemistry and biology indicated that clearcutting forest lands affected streams throughout New England. The magnitude of differences is such that if erosion and sedimentation are controlled, clearcutting as practiced by foresters today does not drastically change streamwater chemistry or biology. (Author's abstract)

RESPONSES OF THE LOBELIA-EPIPHYTE COMPLEX TO LIMING OF AN ACIDIFIED

Lund Univ. (Sweden). Dept. of Ecology. For primary bibliographic entry see Field 5G. W87-04547

Effects Of Pollution—Group 5C

ALPINE TUNDRA SOIL BACTERIAL RE-SPONSES TO INCREASED SOIL LOADING RATES OF ACID PRECIPITATION, NITRATE, AND SULFATE, FRONT RANGE, COLORADO, U.S.A..

U.S.A.,
Colorado Univ. at Boulder. Inst. of Arctic and
Alpine Research.

Arctic and Alpine Research ATLPAV, Vol. 18, No. 3, p 269-275, August 1986. 4 fig, 1 tab, 54 ref. NSF Grant DEB 80-12095.

Descriptors: *Alpine tundra, *Water pollution effects, *Bacteria, *Soil loading, *Pollution load, *Water pollution sources, *Acid rain, *Nitrates, *Sulfates, *Front Range, Colorado, Lipolysis, Funzi, Nitrifers, Actinomycetes, Denitrifiers,

To determine if the soil bacterial community exhibited a response to perturbations from acid rain, the effects of increased soil loading rates of acid precipitation, nitrate, and sulfate on the alpine tundra soil bacterial community were investigated under field conditions along Niwot Ridge, Colorado. During late June and July three concentrations, in a total volume of 10 L representing 2.5, 5, and 10 times the normal soil loading rates of H2SO4/HNO3, SO4(2-)/NO3(-), and NO3(-) were applied in an aqueous solution weekly to separate 1-sq m test plots. After three applications samples were collected from each test plot, untreated control plots, and control plots where an equivalent amount of water was added. It was determined that increased soil loading rates of acid were significantly associated with decrease in the total soil bacterial population, bacterial diversity, populations of nitrifiers, and populations expressing lipolytic activity compared to the water control. In contrast, significant increase in the actinomycete population, fungal population, and populations expressing proteolytic activity were associated with an increase in acid soil loading rates. Populations of nitrifiers, and nitrogen fixers were significantly inhibited by increased soil loading rates of NO3(-) and NO3(-)/SO4(2-) mixtures. Denitrifiers and organisms exhibiting proteolytic activity increased with addition of NO3(-) to the soil. The results indicated that the bacterial community exhibited an immediate dosage dependent response to this type of perturbation. (Author's abstract)

ESTIMATING CATCHMENT WATER QUAL-ITY RESPONSE TO ACID DEPOSITION USING MATHEMATICAL MODELS OF SOIL ION EXCHANGE PROCESSES,

ION EXCHANGE PROCESSES, Virginia Univ., Charlottesville. B. J. Cosby, G. M. Hornberger, E. B. Rastetter, J. N. Galloway, and R. F. Wright. Geoderma GEDMAB, Vol. 38, No. 1-4, p 77-95, September 1986. 6 fig. 3 tab, 38 ref.

Descriptors: *Water pollution effects, *Acid rain, *Ion exchange, *Soil chemistry, *Catchment areas, *Water quality, *Surface water quality, *Acid deposition, *Model studies, *Mathematical models, Mathematical equations, Anion retention, Cation exchange, Alkalinity, Minerals, Shenandoah National Park, Adsorption.

A mechanistic, process-oriented model of the effects of acidic deposition on the chemistry of waters delivered from terrestrial systems to associated streams was developed. The model was based on quantitative representations of soil processes that were considered to be important in determing surface water quality in small forested catchments in temperate, humid climates; anion retention (e.g. sulfate adsorption), cation exchange, alkalinity generation by carbonic acid dissociation, dissolution of aluminum minerals and mineral weathering. The implications of point models of soil ion exchange processes on catchment dynamics were explored by applying the model to an intensively studied catchment in Shenandoah National Park, Virginia (USA). The sensitivity of the results to the assumed mathematical representations of soil processes was investigated and implications of the sensitivity analysis were discussed. Severe limitations on the predictability of catchment response and on the design of the model were explained. (Wood-PTT)

EPIDERMAL TUMORS IN MICROSTOMUS PACIFICUS (PLEURONECTIDAE) COLLECTED NEAR A MUNICIPAL WASTEWATER OUTFALL IN THE COASTAL WATERS OFF

W87-04587

LOS ANGELES (1971-1983), Southern California Coastal Water Research Project Authority, Long Beach. J. N. Cross.

California Fish and Game CAFGAX, Vol. 72, No. 2, p 68-77, April 1986. 7 fig, 2 tab, 29 ref.

Descriptors: "Water pollution effects,
"Wastewater outfall, "Population exposure, "Epsidermal tumors, "Municipal wastewater, "Capidama tumors, "Fish physiology, "Tumors, Wastewater,
Los Angeles, Palos Verdes Peninsula, Offshore
migration, Fish migration.

The long-term temporal and geographic trends in the incidence of epidermal tumors in the Microstomus pacificus population on the mainland shelf off the Palos Verdes Peninsula are described. From 1971 through 1983, 501 M. pacificus (1.2% of total) with epidermal tumors were collected in 672 otter trawl. Tumors were generally confined to smaller individuals; 2.5% of the fish smaller than 150 mm SL were affected compared to 0.1% of the fish larger than 150 mm SL. The annual incidence of tumors in M. pacificus declined at one of the four sampling sites and remained unchanged at the other three. Geographically, the incidence of tumors was higher closer to the wastewater outfalls. The data suggested that tumorous M. pacificus do not participate in the annual offshore migration to the same extent as unaffected individuals. (Author's abstract)

QUANTITATIVE STRUCTURE-ACTIVITY RE-LATIONSHIPS IN AQUATIC TOXICOLOGY, Utrecht Rijksuniversiteit (Netherlands). Dept. of Veterinary Pharmacology, Pharmacy and Toxicol-

ogy. J. L. M. Hermens. Pesticide Science PSSCBG, Vol. 17, No. 3, p 287-296, June 1986. 1 fig, 5 tab, 72 ref.

Descriptors: *Aquatic toxicology, *Molecular structure, *Reviews, *Pollutants, *Organic compounds, *Physicochemical properties, *Water pollution effects, Risks, Risk assessment, QSAR, Quantitative structure-activity relationships, Toxicity.

Quantitative structure-activity relationships (QSARs) enable the toxicity of aquatic pollutants to be predicted from their physicochemical properties. Several techniques that can be used to obtain QSARs are reviewed and examples of QSAR studies are presented for some important groups of aquatic pollutants; reactive organic halides, anilines, phenols and for some relatively unreactive, non-ionized compounds. Finally, the possibility of applying predicted toxicities in environmental hazard assessment is discussed. (Author's abstract) W87-04615

PREDICTION OF BIODEGRADABILITY BY THE USE OF QUANTITATIVE STRUCTURE-ACTIVITY RELATIONSHIPS: CORRELATION OF BIOLOGICAL OXYGEN DEMAND WITH ATOMIC CHARGE DIFFERENCE, Liverpool Polytechnic (England). School of Phar-

macy.
For primary bibliographic entry see Field 5B. W87-04617

AGRONOMIC VALUE OF THE SEWAGE SLUDGE OF TENERIFE, PHYSICO-CHEMI-CAL CHARACTERISTICS OF THE REFUSE-SLUDGE COMPOST AND RELATED PROD-UCTS,

Centro de Edafologia y Biologia Aplicada de Tenerife (Spain).

For primary bibliographic entry see Field 5E.

INFLUENCE OF AN OZONE, CHLORINE AND CHLORINE DIOXIDE TREATMENT ON MUTAGENIC ACTIVITY IN (DRINKING) WATER, Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Leidschendam (Netherlands). For primary bibliographic entry see Field 5F. W87-04646

GENETIC DIVERSITY AND RESISTANCE TO MARINE POLLUTION, Haifa Univ. (Israel). Inst. of Evolution.

Haifa Univ. (Israel). Inst. of Evolution. E. Nevo, R. Noy, B. Lavie, A. Beiles, and S. Muchtar.

Biological Journal of the Linnean Society BJLSBG, Vol. 29, No. 2, p 139-144, October 1986. 1 fig, 1 tab, 29 ref.

Descriptors: *Water pollution effects, *Bioindicators, *Gastropods, *Genetic diversity, *Marine pollution, *Pollution monitoring, *Niches, *Heterozygosity, Inorganic compounds, Organic compounds, Detergents, Oil, Heavy metals.

Three pairs of species belonging to three genera and families of marine gastropods, Monodonta turbinata, M. turbiformis (Trochidae), Littorina punctata, L. neritoides (Littorinidae), Cerithium scabridum, S. rupestre (Cerithiidae), were tested for resistance to diverse inorganic (heavy metals and NaCl) and organic (detergents and crude oil) pollutants. Each pair consisted of one narrow-niche species with low genetic diversity and one broadniche species with higher genetic diversity. Evidence is presented that in all three cases the species with a higher level of genetic diversity was more resistant to all pollutants than its counterpart. These results suggest that fitness is positively correlated with heterozygosity and support the nichewidth-variation hypothesis in regard to pollutants. The results also have practical implications for the identification of optimum marine species as genetic monitors of pollution. (Author's abstract)

STATUS OF THE FRESHWATER PEARL MUSSEL MARGARITIFERA MARGARITI-FERA L, IN THE SOUTH OF ITS EUROPEAN RANGE.

Bayreuth Univ. (Germany, F.R.). Dept. of Animal Ecology.

Biological Conservation BICOBK, Vol. 38, No. 1, p 1-9, 1986. 3 fig, 2 tab, 17 ref.

Descriptors: *Population dynamics, *Rivers, *Eutrophication, *Pearl mussels, *Mussels, Europe, *Water pollution effects, Extinction, Populations, Galicia.

The freshwater pearl mussel Margaritifera margaritifera L. has declined markedly in the south of its European range. Data collected in 1985 from 12 rivers from which the mussel was formerly recorded indicated that only three are still occupied. It could no longer be confirmed from the Vosges (France) and from Portugal. The most important cause of extinction was probably eutrophication. Two of the three populations which were found in Calicia (Spain) are still reproducing and stable, due to the very low pollution levels in this sparsely settled area. It may be the only remaining river with the original conditions for the pearl mussel in the south of its range though their may be populations which have not been discovered to date. This is of more than just local significance since all over Central Europe the pearl mussel populations are declining. If further deterioration can be prevented, Galicia will therefore be one of the very few places in Europe where the freshwater pearl mussel is able to survive. (Wood-PTT)

RESISTANCE OF NITRITE-EXPOSED CHANNEL CATFISH, ICTALURUS PUNCTATUS, TO HYPOXIA.

HYPOXIA, North Texas State Univ., Denton. Dept. of Biological Sciences.

D. E. Watenpaugh, and T. L. Beitinger.

Bulletin of Environmental Contamination and
Toxicology BECTA6, Vol. 37, No. 6, p 802-807,

Group 5C—Effects Of Pollution

December 1986. 1 tab, 18 ref.

Descriptors: "Water pollution effects, "Sublethal effects, "Population exposure, "Nitrites, "Catfish, "Fish, "Hypoxis, Catfish farming, Fish farming, Aquaculture, Fish physiology, Oxygen, Mortality, Toxicity, Tissue analysis.

Toxicity, Tissue analysis.

Because it had previously been found that nitrite negatively affected the ability of channel catfish to tolerate high temperature, a study was conducted to determine if oxygen tolerance was similarly affected. As a major abiotic environmental limiting factor in aquatic environments, oxygen influences the physiology, biochemistry and behavior of fish and therefore the productivity and economic returns from intensive aquaculture operations. Catfish were exposed to mitrite in glass aquaria with nitrite concentrations chosen to produce a graded, yet sublethal, increase in methemoglobin concentration in the blood. Hypoxic resistance times of the channel catfish were determined by removal of oxygen from reconstituted water and leaving the fish blood was then analyzed for hemoglobin and methemoglobin concentrations. It was demonstrated that acute sublethal exposure of channel catfish to nitrite reduced their ability to survive subsequent low oxygen exposure, and it was inferred that the toxic effects of nitrite on catfish could increase mortality or aggravate stress associated with environmental hypoxic conditions. (Wood-PTT) PTT) W87-04660

AVOIDANCE BEHAVIOR AND SWIMMING ACTIVITY OF FISH TO DETERMINE PH CHANGES

shi Univ., Kofu (Japan). Dept. of Environ-Yamar mental Engineering.

P. Nasamura.

Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 6, p 808-815, December 1986. 4 fig., 16 ref.

Descriptors: *Water pollution effects, *Bioindica-tors, *Acidic water, *Fish, *Fish behavior, *Hy-drogen ion concentration, *Mathematical equa-tions, *Avoidance behavior, Behavior, Environ-mental quality, Water quality, Chemical pollution, Fish swimming activity, Minnows.

Fish initially respond to an environmental perturbation by changing their behavior, including alterations in swimming activity or reactions like avoidance or struction. Conclusive evidence was presented to show that fish behavior offers an adequate tool to detect chemical pollution. The use of R-value for swimming activity and D squared-value for avoidance behavior of fish as early warning methods to indicate the development of toxic conditions was discussed based on experimental data on pH effects. Appropriate equations were derived. (Wood-PITT)

ACUTE TOXICITY OF TRICHLOROETHY-LENE TO SALTWATER ORGANISMS, ital Science and Engineering, Inc.,

Gainesville, P.L. G. S. Ward, A. J. Tolmsoff, and S. R. Petrocelli. Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 6, p 830-836, December 1986, 3 tab, 11 ref.

Descriptors: *Water pollution effects, *Trichlor-oethylene, *Saline water, *Seawater, *Seawater organisms, Aquatic life, Algae, Invertebrates, Fish,

Although trichloroethylene (TCE) is widely distributed, relatively limited data exists on its acute effects on aquatic organisms, especially saltwater species. Results of static acute tests of TCE with saltwater alga, invertebrate, and fish were reported to enhance the data base and these results were compared to previous ones for similar organisms. It was found that it was important to assess the possible consequences of solvents and temperature on the toxicity of TCE since it volatilizes from the water so rapidly. This seemed especially true in the

light of the apparent inversion in relative sensitivi-ty between grass shrimp and mysid tested with TCE. The typically more tolerant grass shrimp tested with solvent and at a higher relative temper-ature was more sensitive to TCE than the general-ly acknowledged more sensitive mysid tested at a lower temperature without the aid of a solvent.

EFFECT OF SYNTHETIC DETERGENTS ON GERMINATION OF FERN SPORES, National Botanical Research Inst., Lucknow

(India); Y. Devi, and S. Devi. Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 37, No. 6, p 837-843, December 1986. 7 fig. 1 tab, 22 ref.

Descriptors: *Water pollution effects, *Bioassay, *Detergents, *Fern spores, *Germination, *Phytotoxicity, *Linear alkylbenzene sulphonates, Soaps, Surfactants, Toxicity, Water pollution, Aquatic ferns, Incubation, Growth, Morphology.

The study of the effect of linear alkyl benzene sulphonate (LAS) on the germination of the spores of a fern, Diplazium esculentum was aimed at the development of spore germination assay for phytotoxicity evaluation. The data obtained by incubating spores with solutions of different concentrations of LAS showed that LAS levels above 0.001% are toxic to ferns. It was evident that the tions of LAS showed that LAS levels above 0.001% are toxic to ferns. It was evident that the fern spore germination assay could be developed as a simple sensitive test and reliable screening system for phytotoxicity since the test compounds can be incorporated into the liquid or solid media and viability growth patterns and morphology can be studied. (Wood-PTT) W87-04664

MERCURY, CADMIUM, AND LEAD IN BRIT-ISH OTTERS, Essex Univ., Colchester (England). Dept. of Biol-

For primary bibliographic entry see Field 5B. W87-04665

CHLORINATION OF 4-HYDROXYCINNAMIC ACID AND ITS TOXIC RISK AS A NATURAL OCCURRING WATER CONTAMINANT, Reading Univ. (England). Dept. of Physiology and Biochemistry.
For primary bibliographic entry see Field 5F. W87-04667

USE OF SERUM ANTIBODY AS A MEANS TO DETERMINE INFECTIONS FROM EXPOSURE TO WASTEWATERS AND REFUSE, Cincinnati Univ., OH. Dept. of Environmental Health For primary bibliographic entry see Field 5A. W87-04668

TECHNIQUES FOR THE ASSESSMENT OF CARCINOGENIC RISK DUE TO DRINKING WATER CONTAMINANTS, Environmental Protection Agency, Washington, DC. Office of Drinking Water.
C. R. Cothern.
CRC Critical Reviews in Environmental Control CCECAU, Vol. 16, No. 4, p 357-399, 1986. 9 fig. 17 tab. 124 ref.

Descriptors: *Risk assessment, *Mathematical equations, *Water pollution effects, *Population exposure, *Carcinogens, *Drinking water, *Reviews, *Health effects, *Risks, Assessment techniques, Potable water, Pollutants, Quantitative analysis.

The general techniques of quantitative risk assessment were reviewed and examples of how these techniques are applied for several different drinking water contaminants were presented. Some of the important aspects involved in the use to which risk seessments are nut were also presented since assessments are put were also presented since end-use needs help to shape the structure of

risk assessments. The methodology for assessment of carcinogenic risk due to drinking water contaminants involves four components: exposure assessment, analysis of health effects including individual risk estimation, development of population risk assessments, and uncertainty analysis. Discussion of assumptions, appropriate equations and some individual case studies were included. (Wood-PTT)

CONTAMINANTS IN DRINKING WATER AND CANCER RISKS IN CANADIAN CITIES, Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch D. T. Wigle, Y. Mao, R. Semenciw, M. H. Smith, and P. Toft. Canadian Journal of Public Health CJPEA4. Vo

Canadian Journal of Public Health CJPEA4, Vol. 77, No. 5, p 335-342, September-October 1986. 7 tab, 61 ref.

Descriptors: *Water pollution effects, *Water quality, *Drinking water, *Cancer risks, *Potable water, *Regression analysis, *Statistical analysis, Pollutants, Canada, Carcinogens, Mortality, Chloroform, Trihalomethanes, Asbestos, Statistics.

roform, Trihalomethanes, Asbestos, Statistics.

Associations between mortality rates in 66 Canadian cities and selected drinking water characteristics were analyzed with adjustment for socio-demographic factors. The concentrations of chloroform and total trihalomethanes were significantly associated with chlorine dose. Age-standardized mortality rates for overall mortality (males), all cancers combined (males) and stomach cancer (both sexes) were significantly positively correlated with low education. All-cause (both sexes), total cancer (males) and stomach cancer were significantly negatively correlated with water hardness. Water source and the concentrations of asbestos, chloroform, total trihalomethane except chloroform, and total trihalomethane except chloroform, and total trihalomethanes were not significant sociations between chlorine dose and cancer of the stomach (r = 0.28, p < 0.05). Further analysis of sebestos and mortality in cities matched by water source, chlorination status and size yield-dn o significant correlations. Multiple regression analysis confirmed the direction of the association snoted above for education and hardness, but the strength and statistical significance varied between the two groups of cities studied. Multiple regression analysis confirmed the direction of the association between total organic carbon and cancer of the large intestine among males (beta = 0.29, p < 0.05). sion analysis asic confirmed the association of tween total organic carbon and cancer of the large intestine among males (beta = 0.29, p < 0.05). (Author's abstract) W87-04671

EXTRA INTESTINAL NON-CHOLERA VIBRIO INFECTIONS IN NOVA SCOTIA, Victoria General Hospital, Halifax (Nova Scotia). Dept. of Clinical Microbiology.

M. T. Dalton, O. C. Macintosh, D. Chisolm, and J.

M. Bent.
Canadian Journal of Public Health CJPEA4, Vol.
77, No. 5, p 371-372, September-October 1986. 13

Descriptors: *Water pollution effects, *Recreation *Bacteria, *Infection, *Coastal waters, *Inland waters, *Diseases, *Case studies, Pathology, Nova Scotia, Non-cholera vibrios, St. George's Bay.

Extra intestinal non-cholera vibrio infections are being reported from many coastal and inland areas particularly from North America. Many reports are centered on warm coastal water areas. Canada is not noted for warm coastal waters, but a review of temperatures available during summer months shows certain areas could support growth of non-cholera marine vibrios. Three clinical infections apparently acquired in Nova Scotian coastal waters are reported. (Author's abstract) W87-04673

KINETICS OF HYDROGEN PEROXIDE-SULFURITY) REACTION IN RAINWATER

Effects Of Pollution-Group 5C

COLLECTED AT A NORTHEASTERN U.S.

SITE, Brookhaven National Lab., Upton, NY. Environmental Chemistry Div.
For primary bibliographic entry see Field 2B.
W87-04674

ACIDIC DEPOSITION AND ITS EFFECTS ON THE FORESTS OF NORDIC EUROPE, Sveriges Lantbruksuniversitet, Uppsala. Inst. foer Ekologi och Miljoevaard. F. Andersson. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 17-29, September 1986. 6 fig, 29 ref.

Descriptors: *Air pollution effects, *Water pollution effects, *Water pollution sources, *Acid rain, *Precipitation, *Forests, Trees, Surveys, Soil acidity, Heavy metals, Nutrients, Climatic stress, Cations, Growth, Europe, Deposition.

In Nordic Europe the recent history of acidic deposition and its effects also has a focus on the forest environment. It began with the hypotheses that forests of southern Sweden should have a decreased forest growth and that changes of forest soils are a consequence of an increased load of acidity by the increased airborne pollution. Air pollution effects on the forest of Nordic Europe are analyzed with respect to the situation before and after 1980. No adverse effects were reported up to 1980. Inventories of forest vitality in terms of needle loss or crown density as well as tree growth and after 1980. No adverse effects were reported up to 1980. Inventories of forest vitality in terms of needle loss or crown density as well as tree growth have been made in parts of Norway and the whole of Sweden. For Norway spruce, needle loss was found to increase with tree age and climatic stress with increasing latitude and alititude. However, decreased crown density was also reported for SW Sweden. Needle loss is a non-specific signal not reacting to air pollution alone. Direct effects of gases such as SO2 are not likely to occur, but high episodic levels of O3 have been measured at a level possible leading to chronic injuries. Increasing soil acidity is reported from forests in SW Sweden and also from an alpine locality in southern Norway. A differentiation of biological and deposition-dependent acidification has been attempted. A soil acidification for biological and reposition of the humus and mineral soil layers. An increased release of A1 and heavy metals combined with an increased loss of basic cations is now occurred; Soil acidification probably also results in less available amounts of phosphorus and is suggested to interact with N as limiting forest growth. (Alexander-PTT) W87-04695

GARDSJON PROJECT: LAKE ACIDIFICA-TION, CHEMISTRY IN CATCHMENT RUNOFF, LAKE LIMING AND MICROCATCH-MENT MANIPULATIONS, Swedish Environmental Research Inst., Goete-

H. Hultberg, and P. Grennfelt.

Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 31-46, September 1986. 9 fig, 31 ref.

Descriptors: "Water pollution treatment, "Lake acidification, "Water chemistry, "Gardsjon project, "Catchment areas, "Runoff, "Water pollution effects, "Acid rain, "Liming, Deposition, Land disposal, Fertilization, Forests, Europe, Lakes.

a geological map of Northern Europe, Lakes.

A geological map of Northern Europe shows that areas underlain by lime-poor bedrock predominate in the Scandinavian countries, while most parts of Central Europe have few areas with low weathering bedrock. The Scandinavian countries have large numbers of lakes predominantly in areas with crystalline bedrock while only few lakes are found in Central Europe. The limited neutralizing capacity of soils and bedrock explains why reports on fish decline and dramatic changes in ecosystem structure due to increased acidity in streams and lakes first appeared in Sweden and Norway. The Gardsjon Project is an ecosystem approach in studying acid deposition and its effects on terrestrial parts and lakes within a catchment. The study is an attempt to quantify the processes causing the acidification as well as an analysis of the chemical and biological conditions before liming of the lake and manipulations in microcatchments. A brief

overview of some studies already performed is given and of recently started experiments within the project, such as lake liming, lime application on land, forest fertilization, clearcutting and applica-tions of acid and neutral sulfate on land. (Alexan-

PROJECT RAIN: CHANGING ACID DEPOSITION TO WHOLE CATCHMENTS. THE FIRST YEAR OF TREATMENT,
Norsk Inst. for Vannforskning, Oslo.
For primary bibliographic entry see Field 2B.
W87-04697

ACID DEPOSITION AND EFFECTS IN NORDIC EUROPE, DAMAGE TO FISH POPULATIONS IN SCANDINAVIA CONTINUE TO

Direktoratet for Vilt og Ferskvannsfisk, Trond-heim (Norway). Fish Research Div. B. O. Rosseland, O. K. Skogheim, and I. H.

Sevaldrud. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 65-74, September 1986. 49 ref.

Descriptors: "Water pollution effects, "Acid rain, "Fish populations, "Population exposure, "Lakes, Atlantic salmon, Trout, Brown trout, Perch, Rivers, Fish kills, Water quality, Scandanavis, Deposition, Migration, Smolts.

Deposition, Migration, Smolts.

The losses of freshwater fish populations in Scandinavia due to acidic precipitation have been well documented. Although the decline in fish populations due to acidic water in Norway started as early as in the 1920's the most rapid losses appeared during the 1960-70's. Until 1978, the populations of Atlantic salmon had disappeared from the southernmost part of Norway, and in these areas, more than half of the brown trout populations had been lost. Today, in spite of no increase in acid depositions, the fishery problems seems to continue at the same speed. Data based on interviews of the local fish authority shows that lakes still holding a fish population in the late 70's, have experienced a 30% loss of brown trout populations and a 12% loss of perch in the period 1978-1983. This trend have been confirmed by testfishing in lake systems having long data series. Salmon rivers on the western coast of Norway have experienced several episodes of fish kills due to rapid changes in water quality. These fish kills have mainly affected smolts of Atlantic salmon. Spawning migrating salmon on entering their acidified home riverhave also been affected. In Sweden, several salmon populations along the western coast have been lost due to acidification with no positive trends so far in the 1980's. Areas in central Sweden and in some high mountain areas are still experiencing a continuous and increasing acidification with detrimental effects on invertebrates and fish. In Finland, an increase in acidic deposition during the last decades have occurred, leading to acidification in the effects on invertebrates and fish. In Finland, an increase in acidic deposition during the last decades have occurred, leading to acidification in the most sensitive freshwater systems. Although some acidified freshwater lakes are reported to have lost their fish stocks, few data on fish population effects are available. (Alexander-PTT)
W87-04698

OVERVIEW OF HISTORICAL AND PALEO-COLOGICAL STUDIES OF ACIDIC AIR POL-

LUTION AND ITS EFFECTS,
Maine Univ. at Orono. Dept. of Botany and Plant
Pathology. For primary bibliographic entry see Field 5B. W87-04724

RECENT AND HISTORIC RED SPRUCE MORTALITY: EVIDENCE OF CLIMATIC INFLU-ENCE.

ENCE, Pennsylvania Univ., Philadelphia. Dept. of Land-scape Architecture and Regional Planning. A. H. Johnson, A. J. Friedland, and J. G. Dushoff. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 319-330, September 1986. 4 fig., 40 ref. EPA Interagency agreement DW 89931334-01-0.

Descriptors: *Water pollution effects, *Air pollution effects, *Climatic effects, *Mortality, *Red

spruce trees, *Air pollution, *Forests, Growth, New York, Vermont, New Hampshire.

A period of declining growth and extensive mor-tality of red spruce (Picea rubens Sarg.) has been in progress for the past two decades in the montane forests of New York, Vermont and New Hampprogress for the past two decades in the montane forests of New York, Vermont and New Hampshire. Those areas are subject to particularly high levels of pollutant input and there is concern that airborne chemicals have destabilized the forest ecosystems. Field reports indicate that major episodes of mortality also occurred prior to the era of widespread industrial pollution, particularly in the 1870's and 1880's. The present and past periods of mortality have similarities as well as differences, and whether the primary causes are the same cannot be confidently determined with the information currently available. One similarity is that recent and past episodes of red spruce mortality tended to occur during or immediately after periods which are climatically unfavorable for this species. (Author's abstract) ecies. (Author's abstract) 787-04725

REVIEW OF THE CHEMICAL RECORD IN LAKE SEDIMENT OF ENERGY RELATED AIR POLLUTION AND ITS EFFECTS ON LAKES, Maine Univ. at Orono. Dept. of Geological Sci-

For primary bibliographic entry see Field 5B. W87-04726

CHANGES IN FISH POPULATIONS IN SOUTHERNMOST NORWAY DURING THE LAST DECADE,
Direktoratet for Vilt og Ferskvannsfisk, Trond-

heim (Norway).

I. H. Sevaldrud, and O. K. Skogheim.

Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 381-386, September 1986. 3 fig. 18 ref.

Descriptors: "Acid rain, "Water pollution effects, "Fish populations, "Water analysis, "Lakes, Trout, Brown trout, Perch, Water quality, Norway, Acid lakes, Population dynamics, Population exposure, Fish physiology.

Brown trout (Salmo trutta L.) and perch (Perca fluviatilis L.) are the most widespread species in the acidified areas in the four southernmost counties in Norway. Up to 1978 51% of the brown trout populations and 27% of the perch populations in this area were lost. Several investigations in the 1980's indicate that the deterioration of fish population is acidified area in southern Norwales. in the 1980's indicate that the deterioration of fish populations in acidified areas in southern Norway continues despite of the constant level of acidic precipitation during the last decade. The fish status in lakes in the counties Aust-Agder and Vest-Agder which in 1978 were reported to have fish was updated. The lakes were also surveyed in order to establish basic relationship between water quality and fish population status and changes. The status and change in fish populations during the period from 1974-78 to 1983 were highly related to water quality status. (Alexander-PTT)

ECOLOGICAL EFFECTS OF ACIDIFICATION ON PRIMARY PRODUCERS IN AQUATIC SYSTEMS, Toronto Univ. (Ontario). Dept. of Botany. P. M. Stokes. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 421-438, September 1986. 3 tab, 62 ref.

Descriptors: *Water pollution effects, *Acid rain, *Acid lakes, *Primary producers, *Acidification, *Phytoplankton, *Periphytes, *Macrophytes, Species diversity, Biomass, Nutrients, Metals, Aquatic plants, Growth, Lakes, Sweden, Toxicity.

While a great deal of attention has been paid to the relationship between decreasing pH of surface waters and loss or decline of fish populations, more recently some emphasis has also been given to the effects of acidification on communities and populations of lower trophic levels. For each of the aquatic communities of the phytoplankton, the perphyton and the macrophytes, recent studies of community structure related to acidification are

Group 5C-Effects Of Pollution

reviewed. While biomass and productivity do not generally decrease, there are rather consistent decreases in species richness and profound changes in species composition as pH decreases. It is unclear whether these changes result from the effect of H(+), lowered concentrations of nutrients, change in chemical form of nutrients, toxic metals, or alterations in grazing pressure, but evidence for each of these is considered. We have most information on the plankton, less on periphyton and little on macrophytes. The massive invasion of Sphagnum and the resulting oligotrophication hypothesized to have occurred in Swedish lakes does not seem to be occurring in other regions under acid stress. Implications for the aquatic ecosystems as a result of these structural changes include loss of resilience in the plant communities, abotiat effects related to excessive growth of periphyton and macrophytes, modification of nutrient cycling by the benthic mats, and alteration of the food base for grazers. More studies are required on functional changes in primary producer communities related to acidification; these will lead to more testable hypotheses concerning mechanisms. (Alexander-PTT) hypoti PTT) W87-04734

INFLUENCE OF ACIDIC POND WATER ON AMPHIBIANS: A REVIEW, Pennsylvania State Univ., University Park. Program in Ecology.

Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 439-450, September 1986. 3 tab, 59 ref.

Descriptors: *Acid rain, *Water pollution effects, *Acid ponds, *Amphibians, *Reviews, Reproduction, Mortality, Toxicity, Embryos, Larvae, Population exposure, Hatching, Organic acids, Recruitment, Acidification, Ponds, Acid water, Monitor-

The toxic nature of surface waters low in pH and the resulting influence on the distribution and abundance of aquatic organisms have been recognized for several decades. Early studies were conducted within the naturally acidic sphaganum and cedar bogs of Michigan and the New Jersey pine barrens. A possible effect of acidic precipitation on amphibians was first reported in 1976. High mortality of embryos of the spotted salamander (Ampsystoma maculatum) in acidic ponds near Ithaca, New York was observed. These observations paralleled results of laboratory bioassays at similar pH³s, implicating low pH as the source of toxicity. Acidic pond water may influence the reproduction of amphibians by causing direct mortality of embryos and larvae, and/or by disrupting trophic relationships between amphibians and other aquatic organisms. The embryo is the most sensitive stage of development and may abort soon after exposure to very low pH or eventually fail to hatch at a more moderate pH. Larvae are killed by disruption of Na and Cl balance. The toxicity of pond water is governed by complex interactions of All The toxic nature of surface waters low in pH and pond water is governed by complex interactions of pH, temperature, and the concentrations of Al, Ca, and organic acids. The reduction in recruitment associated with acidification of ponds affects both the local distribution and abundance of amboth the local distribution and abundance of amphibians. The relative importance of different mechanisms of acidification of amphibian breeding sites is unknown. Amphibian breeding ponds are generally small, low in buffering capacity, and darkly stained by humic substances, making it difficult to discriminate between the contribution of acid from atmospheric input and natural sources (such as sphagnum and organic acids). It is however quite clear that temporary ponds are extremely vulnerable to acidification by rain and that they require continued monitoring in order to detect future changes in biological and/or chemical characteristics. (Alexander-PTT)

ECOLOGICAL EFFECTS OF ACIDIFICATION ON TERTILARY CONSUMERS, FISH POPULA-TION RESPONSES, Direktoratet for Vilt og Ferskvannsfisk, Trond-

heim (Norway). B. O. Rosseland

Water, Air and Soil Pollution WAPLAC, Vol. 30,

No. 1/2, p 451-460, September 1986. 79 ref.

Descriptors: *Water pollution effects, *Acid rain, *Fish populations, *Acidification, *Population exposure, Water quality, Seasonal variation, Spawning, Reproduction, Mortality, Fish eggs, Salmon, Salinity, Smolts, Migration, Fish physiology.

The historical and present data on disappearance of fish populations in acidified areas, leaves no doubt to the reason; low pH, elevated levels of Al and low concentrations of ions such as Ca and other factors which can ameliorate the toxic effects. Although all trophic levels in aquatic ecosystems are affected during acidification, the disappearance of fish populations have been given greatest concern. Acidification effects fish populations in various ways, dependent on several factors of biotic and abiotic nature. The most important abiotic factor is water quality and its variability in various ways, dependent on several factors of biotic and abiotic nature. The most important abiotic factor is water quality and its variability through season and during episodes. Among important biotic factors are fish species, development stages and spawning strategy. Also the specimens residence at time of toxic water and their ability to seek areas of better quality (refuges), are of main importance. For inland populations, reproduction failure seems to be the most important factor for population losses. Which lifestage being most affected might, however, differ from one population to another, even among the same species. Eggs and alevins have been considered to be the most sensitive stages, although high mortality of post-spawners have been reported from several lakes. Anadromous species, like Atlantic salmon, have stages of development that are particularly sensitive to changes in water quality. These stages are connected to physiological changes when preparing for change in salinity (smoltification and return from sea). Unfortunately these physiological changes of concides with the most critical environment periods; spring melt and autumn rain. (Alexander-PTT) ment periods; spring melt and autumn rain. (Alex-ander-PTT)

FISH RESPONSES TO ACIDITY IN QUEBEC

LAKES: A REVIEW,
Quebec Ministere de l'Environnement, Sainte-Foy.
J.-J. Frenette, Y. Richard, and G. Moreau.
Water, Air and Soil Pollution WAPLAC, Vol. 30,
No. 1/2, p 461-475, September 1986. 7 fig. 3 tab, 45

Descriptors: *Acid lakes, *Water pollution effects, *Reviews, *Fish populations, *Acid rain, Acidity, Brook charr, Population density, Growth, Gills, Aluminum, Biomass, Lakes, Fish, Perch, Toler-

ance. To establish the impact of acidity on fish populations, studies were conducted in 37 Quebec lakes located in four regions; the reserve des Lourentides and Portneuf and the Charlevoix and Temiscamingue regions. Density (catch per unit effort) of brook charr (Salvelinus fontinalis) decreases with increasing acidity. Moreover, in the Charlevoix region, this species has disappeared from three acid lakes (4.6 < or = pH < or = 5.1) with low Ca levels. Unlike growth, condition demonstrates a close relationship to acidity in brook charr populations. The total Al concentration in gills decreases with increasing size and pH. Lake acidity and sensitivity to acidification introduces problems in gamefish management. A survey of 17 lakes of the Temiscamingue region reveals that species diversity and total fish biomass are much lower in acid lakes than non acid lakes. In addition, two acid lakes are devoid of fish. Cyprinidae and Johnny darters (Etheostoma nigrum) are abundant two acus sakes are devote or rish. Cyprinidae and Johnny darters (Etheostoma nigrum) are abundant in lakes with a pH level of 5.9 to 7.0 but are absent in lakes with a pH lower than 5.2. The yellow perch (Perca flavescens) is the only fish that appears to be tolerant to a wide pH range. This species, however, is in poor condition in acid lakes as compared with non acid lakes. (Author's abstract) stract) W87-04737

FISH SPECIES DISTRIBUTION IN RELATION TO WATER CHEMISTRY IN SELECTED

Maine Univ. at Orono. Dept. of Zoology.

S. J. Pauwels, and T. A. Haines Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 477-488, September 1986. 1 fig, 5 tab, 30

Descriptors: *Water pollution effects, *Acid rain, *Fish populations, *Acid lakes, *Species distribution, Water chemistry, Acidity, Brook trout, Maine, Lakes, Species diversity, Reproduction, Sucker, Shiner, Fish physiology, Habitats.

Sucker, Shiner, Fish physiology, Habitats.

The mean annual volume-weighted pH of the precipitation currently falling on the northeastern United States is between 4.2 and 4.4. Large areas of New England, including Maine, are underlain by bedrock that is low in acid neutralizing capacity. A previous study showed that in about 8% of the lakes surveyed in northern New England pH was < 5.0, and in about 40% the acid neutralizing capacity (ANC) was < 100 micro eq/L. However, no data were collected during that study to ascertain the relation between fish populations and lake acidity. The possible effects of acidity on fish species assemblages in Maine lakes were not subject to local perturbation was measured. The number of fish species in 22 lakes in Maine, ranging in pH from 4.4 to 7.0 (mean values) was determined. No fish were caught in three lakes with pH 5.0, but 1 to 9 species were collected in the remaining 19 lakes (pH 5.4 to 7.0). Brook trout (Salvelinus fontinalis), golden shiners (Notemigonus crysoleucas), and white suckers (Catostomus commersoni) were ubiquitous, but no common shiners (Notropis cornutus) or creek chubs (Semothus transculatus) were collected from lakes with pH below 6.0 and 5.9, respectively. The fishless lakes differed from the others primarily in waster chemistry variables related to acidity, i.e., pH, Al, and concentration of divalent cations. Among lakes that contained fish, the factors related to the and concentration of divalent cations. Among lakes that contained fish, the factors related to the lakes that contained fish, the factors related to the number of species collected were lake surface area and maximum depth, which may be related to habitat quantity and diversity. Cluster analysis identified two distinct fish species groups - depauperate and cyprinid-sucker - but multiple comparison analysis failed to relate any measured chemical or physical variable to these two groups, probably because water chemistry was suitable for reproduction by these species. (Alexander-PTT)

FISH SPECIES DISTRIBUTION AND WATER CHEMISTRY IN NOVA SCOTIA LAKES,

Nova Scotia Dept. of the Environment, Halifax. D. L. Smith, J. K. Underwood, J. G. Ogden, and B. C. Sabean

Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 489-496, September 1986. 4 fig, 2 tab, 25

Descriptors: *Water pollution effects, *Fish populations, *Acid lakes, *Species distribution, *Acid rain, Water chemistry, Nova Scotia, Lakes, Ions, Metals, Water analysis, Regression analysis, Popu-

The sensitivity and loss of fish species from acidic deposition in lakes has been documented. Increasing acid levels affect fish directly through H(+) toxicity, and indirectly through reproductive and recruitment failure, histopathologic changes in tissues, degradation of spawning sites, disruption of the food chain, and Al toxicity. During the summers of 1981-1984, 19,714 fish (23 species) were ented in 23 4 Nova Scotian lakes. Surface and middepth water samples were also analyzed for major ions, metals, and DOC. Lakewater pH varied from 4.4 to 7.7, including eight lakes which produced no fish in standard 23-hr net sets. Fish data were partitioned into 6 pH groupings for analysis. Stepfish in standard 23-hr net sets. Fish data were partitioned into 6 pH groupings for analysis. Stepwise multiple regressions of fish species vs. H(+), SO4, Al, Fe, and Mn showed little predictive power. Productive lakes ranged up to 530 microgram(ug)/L Al, 1680 ug/L Fe, and 836 ug/L Mn. Apart from pH, fish distribution and abundance showed no significant relationships with water chemistry data. We note, however, that the more acidic lakes had fewer species of fish. (Alexander-PTG)

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Effects Of Pollution—Group 5C

AVOIDANCE OF LOW PH AND ELEVATED AL CONCENTRATIONS BY BROOK CHARR (SALVELINUS FONTINALIS) ALEVINS IN

(SALVELINUS FONTINALIS) ALEVINS IN LABORATORY TESTS. Guelph Univ. (Ontario). Dept. of Zoology. J. M. Gunn, and D. L. G. Noakes. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 497-503, September 1986. 3 fig. 1 tab, 17 ref. NRC (Canada) Contract DSS 20ST 310484-

Descriptors: *Water pollution effects, *Fish behavior, *Avoidance response, *Alevins, *Aluminum, *Acid rain, Brook charr, Toxic levels, Toxicity,

Acidification.

Near the end of the yolk absorption period, brook charr (Salvelinus fontinalis) emerge from the gravel of the redd, fill their gas bladder and commence exogenous feeding. This shift from embryonic to juvenile life style not only involves morphological and physiological changes in the fish, but potentially exposes alevins to abrupt physiochemical changes in the water as they move from the interstitial to the surface environment. In areas receiving acidic precipitation, the surface waters are often far more acidic than the upwelling groundwater that percolates through the redd. These chemical differences may be further exaggerated if emergence coincides with the pH depressions in surface waters that often accompany snowmelt. Laboratory studies were conducted to test the ability of brook charr alevins, the earliest free-swimming life stage of the species, to detect and avoid toxic levels of H(+) and inorganic Al. Alevins were tested in steep gradient choice tanks using a range of H(+) (pH 4.0 to 5.5) and Al (0 to 500 microgram (ug)/L) concentrations in low Ca (2.0 mg/L) water. The young brook charr actively avoided acidic water with a pH < 5.0. Aluminum additions of 500 ug/L increased the avoidance response. The observed behavioral response of alevins to low pH and elevated levels of Al, may be significant adaptive advantage in systems undergoing acidification. (Alexander-PTT)

BONE CONCENTRATION OF MANGANESE IN WHITE SUCKER (CATOSTOMUS COMMERSONI) FROM ACID, CIRCUMNEUTRAL AND METAL-STRESSED LAKES, Toronto Univ. (Ontario). Dept. of Zoology. H. H. Harvey, G. A. Fraser, and J. M. McArdle. Water, Air and Soil Pollution WAPLAC, Vol. 30, No. 1/2, p 515-521, September 1986. 3 fig., 3 tab, 22 ref.

Descriptors: *Water pollution effects, *Fate of pol-lutants, *Acid lakes, *Tissue analysis, *Manganese, *Fish populations, *Population exposure, *Bioac-cumulation, *Acid rain, Accumulation, Heavy metals, Mining wastes, Species diversity, Lakes, White sucker, Ontario.

Four hundred and thirty-five white suckers were collected from 24 lakes in 7 regions (Wawa, La Cloche, Parry Sound, Algonquin, Muskoka, Haliburton, North Bay) of Ontario, concurrent with measurement of pH, alkalinity and 18 metals and ligands. Lakes Summit and Moran have been contaminated by the dumping of mine tailings. One hundred and seventy-eight fish of six additional species were collected from two of the lakes. Vertebral central were analyzed by neutron activations. nundred and seventy-eight isn of six additional species were collected from two of the lakes. Vertebral centra were analyzed by neutron activation analysis Manganese concentration in lake water was correlated with H(+), Y=0.024+5914X, r squared = 0.79, p<0.0001, n=22. In vertebral centra, Mn differences between lakes (range of population means, 0.223 to 2.42 meq/100g dw). Bone Mn was correlated positively with lake Mn (r squared = 0.55, p<0.001) and negatively with DOC (r squared = 0.36, p<0.01); lake Mn and DOC were not correlated. In stepswise multiple regression, lake Mn + DOC + alkalinity accounted for 87% of the variance in bone Mn. Concentration factors, calculated as bone Mn / lake Mn were 1,000 to 4,000X for many fish populations, with the lowest values from the two tallings-contaminated lakes, and the highest C. F.'s from lakes of lowest Mn in water, implying some degree of regulation of Mn uptake by the fish. Bone Mn of pelagic and littoral fishes were significantly lower than those

found in the benthic-feeding white suckers. (Author's abstract) W87-04742

DEGRADATION OF SPARTINA LIGNOCEL-LULOSE BY INDIVIDUAL AND MIXED CUL-TURES OF SALT-MARSH FUNGI, George Mason Univ., Fairfax, VA. Dept. of Biol-

ogy.

A. P. Torzilli, and G. Andrykovitch.

Canadian Journal of Botany CJBOAW, Vol. 64,

No. 10, p 2211-2215, October 1986. 1 tab, 27 ref.

Descriptors: *Water pollution effects, *Biodegradation, *Salt marshes, *Decomposing organic matter, *Fungi, *Lignocellulose, Hemicellulose, Lignin, Statistics, Nitrogen, Incubation, Fertilizers,

Nutrients.

Spartina alterniflora tissue, either in the absence or the presence of a nitrogen supplement, was inoculated with a single-species or mixed-species inoculum of salt-marsh fungi. After 42 days of incubation at 25 C, lignocellulose decomposition was determined by measuring the amount of residual total lignocellulose, and lignin. A two-way analysis of variance of these results indicated an interaction between fungal treatments and N treatments. Pairwise comparisons of mean residual weights showed that all individual and mixed fungal inocula resulted in significant degradation of the total lignocellulosic, cellulosic, and hemicellulosic fractions of Spartina tissue with levels of decomposition ranging from about 16-40%, depending on the fungal-N treatment and the Cell wall fraction examined. Lignin degradation was not detected for any of the treatments. Cultures with a mixture of fungi showed less decomposition than was observed for the most efficient decomposer when it occurred alone. (Author's abstract) W87-04819

EPIDEMIOLOGY AND EARLY DIAGNOSIS OF PRIMARY LIVER CANCER IN CHINA,

Guangxi Medical Coll., Nanning (China). Y. Fu-Sun, and S. Kong-Nein. Advances in Cancer Research ACRSAJ, Vol. 47, p 297-329, 1986. 11 tab, 62 ref.

Descriptors: *Public health *Epidemiology, *Cancer, *China, *Liver, *Risk factors, *Drinking water, *Water pollution effects, Primary hepatic cancer, Hepatitis B virus, Vaccination, Alpha-feto-protein, Diagnosis.

Epidemiological studies in different areas in China have revealed several outstanding risk factors of primary liver cancer (PLC): hepatitis B virus (HBV) infection, pollution of drinking water, contamination of food by aflatoxin B and/or nitrosation of facility residential to the Accordination. amination of food by aflatoxin B and/or nitrosamines, and family predisposition. Accordingly, a program of HBV vaccination, improved supply of drinking water, better preservation and storage of food, and possibly chemoprevention for high-risk populations should be effective preventive measures. Frequent alpha-fetoprotein (AFP) screening in high-risk populations is highly recommended to detect early cases of PLC. Careful follow-up of the dynamic changes in AFP in individuals with persistent low levels of positive AFP is important for distinguishing other conditions from PLC. Although much work remains to be done on etiological agents of PLC and the mechanism of oncogenesis, it is time that larger scale control measures be put into effect in high-incidence areas to discover if one of the most common cancers in the world can be controlled. (Rochester-PTT)

EFFECTS OF DRILLING FLUIDS ON THA-LASSIA TESTUDINUM AND ITS EPIPHYTIC ALGAE

University of West Florida, Pensacola. Dept. of

University of west Florated Biology. W. A. Price, J. M. Macauley, and J. R. Clark. Environmental and Experimental Botany EEBODM, Vol. 26, No. 4, p 321-330, October 1986. 3 fig, 3 tab, 22 ref.

Descriptors: "Water pollution effects, "Pollution exposure, "Drilling fluids, "Algae, "Thalassia testudinum, "Sea grasses, "Productivity, "Clays, "Biomass, Seasonal variation, Offshore platforms, Microenvironments, Waste disposal, Toxicity.

A flow-through microcosm system was developed to assess the potential influence of drilling fluids on Thalassia testudinum and its epiphytic algae. Driling fluid and montmorillonite clay treatments and a control were used for seven tests. Six week exposure to drilling fluid reduced epiphyte biomass, but the surviving algae did not differ from controls. Thalassia productivity measured as carbon uptake and growth rate was reduced by a ten-day exposure to drilling fluid concentrations of 200 and 1000 microliters per liter. Thalassia productivity was reduced by drilling fluid exposure in summer and fall but not in spring. This variation in response is attributed to seasonal changes in Thalassia allotment and storage of carbohydrates. The effect of montmorillonite clay exposer varied inconsistently among all tests for both Thalassia and epiphytes. (Author's abstract)

EFFECTS OF ACIDITY OF SIMULATED RAIN AND ITS INFLUENCE ON THE PHYTOTOXICITY OF CHLORSULFUNON ON VELVETLEAF AND BARLEY, Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Plant Pathology and Physiology. W. Mersie, and C. L. Foy. Environmental and Experimental Botany EEBODM, Vol. 26, No. 4, p 341-347, October 1986. 7 tab, 31 ref.

Descriptors: *Water pollution effects, *Plant physiology, *Herbicides, *Simulated rainfall, *Acid rain, *Phytotoxicity, *Chlorsulfuron, *Barley, *Velvetleaf, *Hydrogen ion concentration, Grain crops, Plant growth, Chlorophyll, Plant tissues, Synergistic effects.

Greenhouse experiments were conducted to determine the influence of simulated acid rain on the phytotoxicity of chlorsulfuron, a grain herbicide, on velvetleaf and barley. Plants were grown in a greenhouse with charcoal-filtered air and exposed to rain of three acidity levels and compared with a control. Chlorosulfuron was applied postemergence to seedlings either before or after six 30-minute simulated rain events. Chlorsulfuron rates were 0,1 and 0, 20 grams per hectare on velvetleaf and barley, respectively. Barley showed no discernable response to simulated acid rain and/or chlorsulfuron treatments. The sequence of acid rain exposure in relation to herbicide treatment did not influence the response of velvetleaf to all treatments. At a pH value of 2.5, velvetleaf failed to attain normal height, and leaves were necrotic and wrinkled and abcised prenaturely. Chlorophyll concentration of plants treated with acid rain of pH 2.5 was consistently lower than at higher pH levels. Shoot fresh weight of velvetleaf was reduced at pH 2.5 and the phytotoxicity of chlorsulfuron was enhanced at pH values of 2.5 and 3.4 as compared to pH 5.6. No such synergistic interaction was observed at pH 4.3. Further studies are needed to determine the physiological and biochemical bases of this synergistic interaction between chlorsulfuron and simulated acid rain at the lower pH levels. (Author's abstract)

RESIDENTIAL HEALTH STUDY OF FAMI-LIES LIVING NEAR THE DRAKE CHEMICAL SUPERFUND SITE IN LOCK HAVEN, PENN-

SUPERFUND SITE IN LOCK HAVEN, PENN-SYLVANIA, Pennsylvania Dept. of Health, Harrisburg. Div. of Environmental Health. J. N. Logue, and J. M. Fox. Archives of Environmental Health AEHLAU, Vol. 41, No. 4, p 222-228, July-August 1986. 1 fig, 5 tab, 10 ref.

Descriptors: *Water pollution effects, *Waste disposal, *Lock Haven, *Superfund, *Population exposure, *Waste dumps, *Health effects, *Pollution exhibition, Surveys, Occupational exhaulth, Contamination, Surveys, Occupational exhaulth

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A cross sectional health survey involving a group of residents of the Lock Haven, Pa. area who live in the immediate vicinity of the Drake Superfund site was conducted. A control group of residents was randomly selected from the remaining areas of was randomly selected from the remaining areas of Lock Haven. The study did not indicate the presence of any serious chronic health conditions in the exposed group as compared to the control group. Significantly more individuals in the exposed group experienced skin problems and sleepiness for at least one month before the survey. This may be indicative of a possible association between direct human exposure to toxic chemicals from the site and the manifestation of symptoms. The increased by factors such as stress, occupational exposure or other etiologic agents which are unrelated to contaminants at the Drake site, or may be a spurious finding due to chance or biased reporting. (Author's abstract)

PILOT STUDY OF SERUM POLYCHLORI-NATED BIPHENYL LEVELS IN PERSONS AT HIGH RISK OF EXPOSURE IN RESIDENTIAL AND OCCUPATIONAL ENVIRONMENTS, Centers for Disease Control, Atlanta, GA. Center for Environmental Health.

for Enviro hr-Green, D. Ross, J. Liddle, E. Welty,

and G. Steele.

Archives of Environmental Health AEHLAU,
Vol. 41, No. 4, p 240-244, July-August 1986. 2 tab,

Descriptors: *Path of pollutants, *Waste disposal, *Water pollution effects, *Public health, *Bloomington, *Population exposure, *Waste dumps, *Polychlorinated biphenyls, *Health effects, Occupational exposure, Surveys.

A pilot study was conducted to determine whether persons at high risk of exposure to three waste sites in the area of Bloominton, Indiana have abnormal-ly elevated serum polychlorinated biphenyl (PCB) levels. It was also determined which environmental pathways might have contributed great to these tal pathways might have contributed most to these exposures. A screening questionnaire survey of 995 individuals was conducted. On the basis of this individuals was conducted. On the basis of this data, 114 of the persons who had the greatest potential for exposure were selected for inclusion in the pilot exposure assessment study. People residing near the studied waste sites had higher than average serum PCB levels and a greater percentage had abnormally elevated serum PCB levels as compared with previously characterized populations in the United States. Specific pathways of exposure and uptake could not be distinguished with the exception of those persons experiencing occupational exposure and, possibly, among persons who reportedly salvaged metal from discarded electrical equipment at a local dump site. Exposures in this community require further evaluation. (Author's abstract) (Author's abstract) W87-04828

CRAYFISH PESTICIDE DECIMATES SPAN-

D. MacKenzie. New Scientist NWSCAL, Vol. 112, No. 1530, p 24. October 16, 1986.

Descriptors: *Water pollution effects, *Spain, *Pesticides, *Waterfowl, Marshes, Contamination, Rice, Crayfish, Agricultural development.

About 30,000 birds have been killed as a result of About 30,000 birds have been killed as a result of rice farmers use of an illegal methyl paraben pesticides to control the crayfish population near Spain's Donana National Park, Europe's richest bird sanctuary. Agricultural development has already endangered the park resulting in falling water levels and deliberate drainage of private land in the park for grazing. So far, no birds have died in the park itself, and park managers hope that flushing the marshes with uncontaminated water will prevent this, especially when northern migrawill prevent this, especially when northern migra-tory birds arrive later in the month. (Michael-PTT) W87-04829

PREDICTING AQUEOUS ALUMINIUM CON-CENTRATIONS IN NATURAL WATERS,

Maine Univ. at Orono. Dept. of Botany and Plant Pathology. For primary bibliographic entry see Field 5A. W87-04834

TERATOGENIC EFFECTS OF CADMIUM ON BUFO ARENARUM DURING GASTRULA-TION.

Universidad Nacional de Lomas de Zamora (Argentina). Inst. de Biologia de la Reproduccion y Desarrollo Embrionario.

Desarrollo Embrionario. C. S. Perez-Coll, J. Herkovits, and A. Salibian. Experientia EXPEAM, Vol. 42, No. 10, p 1174-1176, October 1986. 1 fig, 1 tab, 19 ref.

Descriptors: *Water pollution effects, *Population exposure, *Toads, *Cadmium, *Gastrulation, Animal growth, Animal tissues, Animal physiology, Temperature effects, Amphibians, Embryonic growth stage, Cadmium chloride, Heavy metals.

Developing Bufo arenarum embryos were treated during gastrulation with cadmium chloride at several concentrations to establish whether effects such as skeletal malformations, behavioral disorders, delayed development and reduced body size were related to the particular stage of development at which cadmium exposure was experienced. Initial failures at gastrulation resulted mainly in axial incurvations, microcephaly, hydropsy and abnormal tail formation. Higher temperature had a dual effect. At high cadmium concentrations, early malformations were significantly increased, but a lower concentrations, a higher temperature prevented alteration. (Author's abstract) W87-04840

RESPONSES OF FRESHWATER AMOEBAE TO SALINITY CHANGES,

Toho Univ., Tokyo (Japan). Dept. of Biology. N. Oshima, F. Takeda, and K. Ishii. Comparative Biochemistry and Physiology (A) CBPABS, Vol. 85, No. 3, p 395-399, 1986. 5 fig, 1

Descriptors: *Water pollution effects, *Salinity, *Amboebae, *Acclimatization Culturing techniques, Adaptation, Osmotic pressure, Potassium chloride, Calcium chloride, Sucrose.

The response of freshwater amobae to salinity changes and their acclimatization to saline conditions was studied by characterizing body shape, locomotive velocity, and capacity for attachment to a substratum. Two species of amoebae were transferred from the primary culture medium to a transferred from the primary culture medium to a test solution containing potassium chloride or calcium chloride and then rinsed five times with the test solution. The rate of locomotion was determined by timing the transit of amoebae over four or eight divisions of an ocular micrometer with a stopwatch. Locomotive velocity decreased gradually with the decrease in concentration of bathing saline. A sudden decrease in velocity occurred in response to solutions with more than three times the salinity of the culture medium. One species was able to adjust itself to increased salinity within several hours. A step-wise effect in adaptation was also studied. Amoebae left standing in a high salinity concentration for three hours were returned to asso student. Amboose lets standing in a min salimity concentration for three hours were returned to the standard test solution and the rate of recovery to normal locomotion was examined. It was observed that cells which do not lose their ability to served that cells which do not lose their ability to adhere to the substratum during a three hour exposure to very high salt concentration will regain motile activities when returned to a neutral solution. When only osmotic pressure of the surrounding medium was increased by the addition of sucrose, a smaller decrease in velocity and more rapid adaptation was observed in one species. (Michael-PTT) W87-04841

OIL POLLUTION: A DECADE OF RESEARCH AND MONITORING,

Woods Hole Oceanographic Institution, MA Dept. of Chemistry. For primary bibliographic entry see Field 5B. W87-04843

LEPTOSPIROSIS AS AN OCCUPATIONAL

WHO/FAO Collaborating Centre for Research and Reference on Leptospirosis, Hereford (England). S. A. Waitkins.

British Journal of Industrial Medicine, Vol. 43, No. 11, p 721-725, November 1986. 4 fig, 5 tab. 10 ref.

Descriptors: *Descriptors: *Water pollution effects, *Farm workers, *Leptospirosis, *Occupational exposure, *Pathogenic bacteria, *Public health, Epidemiology, Wastewater facilities, Farm wastes, Recreation, Infection.

wastes, Recreation, Infection.

The organism causing leptospirosis is a spirochete belonging to the genus Leptospira that comprises two distinct species, the pathogenic L interrogans and the saprophyte L biflexa. L biflexa is a non-parasite commonly found in fresh water. The presence of biflexa in water is a good indicator that the environmental conditions support the survival of pathogenic leptospires. In the past, occupations associated with water or sewage were at particular risk from leptospirosis, partcularly Weil's disease. The major occupational risk today is among farm workers. There is an additional risk of exposure due to the rapid rise in recreational use of fresh water rivers, canals and lakes. A new emerging hazrds is those infections caused by cattle associated leptospirosis that causes a flu-like illness. Although farmers in the dairy industry are the most likely occupational group to risk this infection, other workers such as verterinarians and butchers are also at risk. The epidemiological spread of leptospirosis has changed. No longer are traditional occupations such as miners, sewer workers and fish factory workers at risk, but today's emerging hazard includes farm workers. (Michael-PTT)

VENTILATORY AND CARDIAC REFLEX RE-SPONSES TO HYPOXIA AND NACN IN LEPI-SOSTEUS OSSEUS, AN AIR-BREATHING

Texas Univ. at Arlington. Dept. of Biology.

Pexas Univ. at Armguon. Dept. of Biology. N. J. Smartresk. Physiological Zoology PHZOA9, Vol. 59, No. 4, p 385-397, July-August 1986. 6 fig, 31 ref. NSF Grant PCM-8317914.

Descriptors: *Water pollution effects, *Gills, *Gar, *Hypoxia, *Fish physiology, *Cyanide, *Respiration, Ventilation, Oxygen requirements, Chemore-

ceptors.

The hypoxic depression of gill ventilation and other ventilatory and cardiovascular responses to hypoxia were studied in the bimodal breather, Lepisosteus osseus. Air-breathing frequency increased hyperbolically as water P sub O2 declined. Gill ventilation response to changes in water P sub O2 was complex. Opercular pressure initially increased as P sub O2 fell, reaching maximum levels between 75 and 125 torr P sub O2. As P sub O2 fell further, opercular pressure decreased to about 50% of its maximum level. Heart rate rose as P sub O2 fell. Gill ventilation frequency did not change significantly with hypoxia. A one-to-one correlation between heart rate and gill ventilation was observed in four of nine fish in which heart rate was measured, during normoxia only. The P sub O2 level in the dorsal aorta (DA) fell with hypoxia, but did not change significantly in the ventral aorta (VA) at any level of aquatic hypoxia. External administration of NaCN had a large stimulatory effect on air-breathing frequency, but did not significantly affect gill ventilation. Internal injections of NaCN into either the DA or VA produced a prolonged stimulation of gill ventilation and transiently stimulated air breathing. hut the response to tions of NaCN into either the DA or VA produced a prolonged stimulation of gill ventilation and transiently stimulated air breathing, but the response to VA injections was much quicker. Heart rate was not significantly affected by NCN. The data suggest that air breathing is initiated on stimulation of external chemoreceptors located in or near the gills, while gill ventilation is controlled by internal chemoreceptors. The depression of gill ventilation seem during the production of the property of the pro gills, while gill ventilation is controlled by internal chemoreceptors. The depression of gill ventilation seen during hypoxia suggests that internal chemor-eceptors are positioned where they are able to sense the increased flow of oxygenated pulmonary blood during intense air breathing. (Author's ab-

Effects Of Pollution—Group 5C

W87-04846

THRESHOLDS IN EUTROPHICATION OF NATURAL WATERS, Tsukuba Univ. (Japan). Inst. of Biological Sci-

For primary bibliographic entry see Field 5A. W87-04853

SELENIUM AND HEAVY METALS IN SAN FRANCISCO BAY DIVING DUCKS, Patusent Wildlife Research Center, Davis, CA. Pacific Coast Field Station. For primary bibliographic entry see Field 5B. W87-04856

ASSESSMENT OF A NATURAL WETLAND RE-CEIVING SEWAGE EFFLUENT, Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irri-gation Research.

M. Finlayson, P. Cullen, D. Mitchell, and A.

Australian Journal of Ecology AJECDQ, Vol. 11, No. 1, p 33-47, March 1986. 4 fig, 10 tab, 46 ref.

Descriptors: *Effluents, *Water pollution effects, *Waste disposal, *Nutrient removal, *Aquatic weed control, *Wetlands, *Wastewater, Turbidity, Hydrogen ion concentration, Conductivity, Dissolved oxygen, Phosphorus, Nitrogen, Seasonal variation, Plant populations, Plant growth, Aquatic weeds, Biomass, Sediments, Performance evalua-

Assessment of the performance of a wetland dominated by opportunistic weeds in removing nutrients from a secondary sewage effluent was studied at Thredbo in Kosciusko National Park. Water quality sampling of the inflow and outflow showed a reduction in turbidity, pH and conductivity with passage through the wetland. Dissolved oxygen levels also decreased. In summer, the phosphorus load was reduced by 44% as wastewater moved through the wetland, and the nitrogen load was reduced by 5%. Winter retentions were 10 and 14% of inflowing loads, respectively. In the second year of the study there was a net release of phosphorus and reduced retention of nitrogen. This resulted from a physical disturbance of the wetland. Vegetation downstream of the effluent inflow was dominated by the opportunistic weeds Epilobium sarmantaceum and Rumex crispus. Carex gaudichaudiana and Baeckea gunniana dominated upstream. Marked seasonal changes in vigor and biomass were recorded Plants, but not sediments, downstream of the inflow contained more nutrients than those upstream. Seed bank analysis showed more seeds downstream than upstream. A moist treatment promoted more seed germination than flooded treatment. E. sarmantaceum and to a lesser extent R. crispus dominated in each treatment. The channels of the wetland have germination than Hooded treatment. E. sarmanta-ceum and to a lesser extent R. crispus dominated in each treatment. The channels of the wetland have been blocked and planted with Phragmites australis and Schoenoplectus validus in a effort to promote greater water retention and replace weed species. (Author's abstract)

STUDIES ON THE ENVIRONMENTAL FATE OF CARBARYL AS A FUNCTION OF PH, Ohio State Univ., Columbus. Dept. of Entomolo-

gy. S. W. Pisher, and T. W. Lohner. Archives of Environmental Contamination and Toxicology AECTCV, Vol. 15, No. 6, p 661-667, 1986. 2 ftg. 4 tab, 24 ref.

Descriptors: *Carbaryl, *Fate of pollutants, *Hydrogen ion concentration, *Toxicity, Microenvironments, Contamination, Biodegradation, Aquatic animals, Metabolism.

The effects of pH on the environmental fate of the pesticide carbaryl were determined in acute toxicity tests, microcosm analyses and abiotic water stability studies. The toxicity of carbaryl varied significantly with pH in 24-hour toxicity tests with Chironomus riparius. Toxicity was greatest at pH

4. The chemical was equitoxic at pH 6 and pH 8. Greater amounts of carbaryl were detected in water at pH 4, both in the microcoam and abiotic studies, than at pH 6 and pH 8. In spite of the marked persistence of carbaryl in water at pH 4, only minor differences were seen in the amount of parent compound in the microcoam organisms as a function of pH because of the facility with which carbaryl was degraded. The hazard associated with aquatic contamination by carbaryl is affected by pH, but is most significant when contamination of the water exceeds the capacity of aquatic biota to metabolize the chemical. These data underscore the need to consider physical factors which affect environmental fate, particularly in environments in which biotic degradation is minimal. (Author's abstract) stract) W87-04876

HEALTH IMPACT OF ACIDIC DEPOSITION, World Health Organization, Copenhagen (Den-

mark). H. E. Allen, M. Benarie, V. Bencko, R. de Boeck, and F. J. J. Brinkmann. The Science of the Total Environment STENDL, Vol. 52, No. 3, p 157-187, July 1986. 3 fig, 1 tab, 140 ref, 2 append.

Descriptors: "Acid rain, "Health effects, "Deposi-tion, "Public health, "Water pollution sources, Drinking water, Contamination, Fate of pollutants, Groundwater, Leaching, Sudden infant death syn-drom, Sediments, Plumbing, Water quality, Hydro-gen ion concentration, Fish, Accumulation, Alka-linity, Trace elements, Mercury, Epidemiology, Watersheds, Monitoring, Air pollution.

The results of a World Health Organization Office for Europe working group investigation of the public health implications of acidic deposition are reviewed. Available data indicate minimal risk to healthy individuals from inhalation of acidic sero-sola at ambient conditions have acidic reviewed. Available data indicate minimal risk to healthy individuals from inhalation of acidic aerosols at ambient conditions, but sensitive groups may suffer pulmonary effects from short term exposures. Acid rain may affect drinking water quality or alter the intake of trace elements by fish, shellfish, game or crops. Leaching of toxic materials from watersheds or sediments into groundwater or surface water can increase acidification of rinking water supplies and reduce drinking water quality. One aspect of acidified sources is the increased agressiveness of water to plumbing materials. Reduction of pH and alkalinity in lakes and streams can enhance mobilization of metals, increase trace element concentration in plants and plankton and lead to enhanced mercury concentration in fish. There is no evidence to suggest that acidic deposition increases the risk of sudden infant death syndrome (SIDS), and indoor air pollution has not yet proved to be a factor. Recommendations for dealing with the acidic deposition problem include establishment of monitoring networks and improving monitoring procedures, additional research on direct and indirect health effects and epidemiological study of a possible association between air pollution and SIDS. (Michael-PTT)

LONG-RANGE AIR POLLUTION: A THREAT TO EUROPEAN FORESTS, For primary bibliographic entry see Field 5G. W87-04891

EFFECTS OF SOIL CONTAMINATION WITH COPPER, LEAD AND ARSENIC ON THE GROWTH AND COMPOSITION OF PLANTS: IL EFFECTS OF SOURCE CONTAMINATION, VARYING SOIL PH, AND PRIOR WATER-LOCKING LOGGING,

Commonwealth Scientific and Industrial Research Organization, Glen Osmond (Australia). Div. of Soils.

Souls. R. H. Merry, K. G. Tiller, and A. M. Alston. Plant and Soil PLSOA2, Vol. 95, No. 2, p 255-269, 1986. 3 fig, 4 tab, 16 ref.

Descriptors: *Bioaccumulation, *Tissue analysis, *Soil contamination, *Copper, *Lead, *Arsenic, *Plant growth, *Plant physiology, *Water pollution effects, *Waterlogging, *Hydrogen ion con-

centration, Vegetation effects, Crop production, Vegetable crops, Acidity, Accumulation, Heavy metals, Soil types, Industrial wastes, Toxicity,

Land application.

The effects of soil pH and prior waterlogging on the uptake of copper, lead, and arsenic by radiah and silver beet were investigated using eight soils. Lead and copper concentrations of the plants decreased with increasing soil pH, the effect being more marked in the more highly contaminated soils. Relatively more copper than lead was translocated to the tops of the radiah plants. Arsenic concentrations were less sensitive to changes in soil pH. Lower yields, lower copper concentrations in silver beet, and toxicity symptoms in some acid soil treatments were more likely due to aluminum and/or manganese than to excess copper, lead, or arsenic. The prior waterlogging treatment had few effects that were interpretable in terms of soil analysis or plant composition. The soils used behaved similarly no matter what the source of contamination, except that soils dosed with copper, lead, and arsenic did not always behave in the same manner as did soils contaminated with orchard sprays in the field, emphasizing problems of interpretation of results obtained with freshly amended soils compared to soils contaminated in the field, Author's abstract)

W87-04896

SALT RESISTANCE OF CHICKPEA GENOTYPES IN SOLUTIONS SALINIZED WITH NACL OR NA2SO4, Volcani Inst. of Agricultural Research, Bet-Dagan (Israel). Inst. of Soil and Water. For primary bibliographic entry see Field 3C. W87-04897

EFFECTS OF SALINITY AND TEMPERATURE ON THE IN VITRO METABOLISM OF THE ORGANOPHOSPHORUS INSECTICIDE FENI-TROTHION BY THE BLUE CRAB, CALLIN-

ECTES SAPIDUS,
Florida Univ., Gainesville. Dept. of Food Science
and Human Nutrition.
For primary bibliographic entry see Field 5B.
W87-04901

EFFECTS OF SIMULATED ACIDIC RAIN ON WASH-OFF OF FUNGICIDES AND CONTROL OF LATE BLIGHT ON POTATO LEAVES, Boyce Thompson Inst. for Plant Research, Ithaca, NY.

A. H. C. van Bruggen, J. F. Osmeloski, and J. S. Jacobson.

Jacobson. Phytopathology PHYTAJ, Vol. 76, No. 8, p 800-804, August 1986. 8 tab, 23 ref.

Descriptors: "Wash off, "Path of pollutants, "Simulated rainfall, "Acid rain, "Fungicides, "Potato blight, "Potatoes, "Plant diseases, "Water pollution effects, Rainfall, Pesticides, Vegetable crops, Acidity, Chromatography, Gas chromatography, Leaves.

Leaves.

The effects of simulated acidic rain at two pH levels (2.8 and 4.6) on removal of five fungicides in each of two formulations (wettable powders and flowables) on three potato cultivars (Norchip, Monona, and Katahdin) were investigated in a series of factorial experiments. Residual fungicide on leaf disks was determined by atomic absorption spectroscopy for maneb, mancozeb, and copper hydroxide, by gas chromatography with electron capture detection for chlorothalonil, and by yeast bioassay for triphenyltin hydroxide (TPTH). Wash-off of TPTH and copper hydroxide from potato leaves was significantly increased by simulated rain at pH 2.8 compared with rain at pH 4.6 regardless of fungicide formulation and potato cultivar. Removal of maneb, mancozeb, and chlorothalonil was not affected by acidity of simulated rain. Regardless of acidity of simulated rain, wettable powders were removed more effectively than flowables. Despite 13-83% removal of fungicides from foliage by simulated acidic rain, late blight control was still significant compared with plants not treated with fungicide. Phytophthora infestans infection of potato leaves sprayed with TPTH was

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er after an acid rain treatment at pH 2.8 than at pH 4.6, but the increased infection was ascribed to enhanced susceptibility of foliage to late blight caused by rain at pH 2.8 rather than to increased removal of the fungicide per se. (Author's abstract) W87-04902

RESTORING THE FLOW OF A FINISHED WATER PIPELINE, Onondaga County Metropolitan Water Board, Clay, NY. For primary bibliographic entry see Field 5F. W87-04904

CHEMICAL PRODUCTS AND TOXICOLOGIC EFFECTS OF DISINFECTION, Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div. For primary bibliographic entry see Field 5F. W87-04910

DIRECT DISTRIBUTION MODEL FOR RE-GIONAL AQUATIC ACIDIFICATION, Carnegie-Mellon Univ., Pittsburgh, PA. Dept. of Civil Engineering. For primary bibliographic entry see Field 5B. W87-04941

REPRODUCTIVE FAILURE IN COMMON SEALS FEEDING ON FISH FROM POLLUTED

COASTAL WATERS, Rijksinstituut voor Natuurbeheer, Texel (Netherlands). Dept. of Estuarine Ecology.

Innus). Dept. of Estatame Ecology. P. J. H. Reginders. Nature NATUAS, Vol. 324, No. 6096, p 456-457, December 4, 1986. 1 fig, 27 ref.

Descriptors: *Coastal waters, *Seals, *Reproductive failure, *Polychlorinated biphenyls, *Path of pollutants, *Rood chains, *Water pollution effects, *Tissue analysis, *Population dynamics, Aquatic animals, Wadden Sea, Netherlands, Aquatic populations, Populations, Pollutants, Fish, Reproductive.

The population of common seal Phoca vitulina in the westernmost part of the Wadden Sea, The Netherlands, has collapsed during the past few decades. Between 1950 and 1975 the population dropped from more than 3,000 to less than 500 animals. Comparative studies of common seal populations from different parts of the Wadden Sea reveal that pup production has declined sharply only in the western (Dutch) part. A comparative toxicological study on the levels of heavy metals and organochlorines in tissue of seals from the western and northern parts of the Wadden Sea shows that only the polychlorinated biphenyl (PCB) levels differ significantly. This is predominantly a result of PCB pollution from the river Rhine, which mainly affects the western (Dutch) part. PCBs are thought to be responsible for the low rate of reproduction in Dutch common seals on the basis of epidemiological and experimental data on the ability of PCBs to interfere with mammalian reproduction. It is reported that the reproductive failure in common seals from the Dutch Wadden Sea is related to feeding on fish from that polluted area. This is the first demonstration of a causal relationship between naturally occurring levels of pollutants and a physiological response in marine mammals. (Author's abstract) marine man W87-04986

OUTBREAK OF GASTROENTERITIS ON A PASSENGER CRUISE SHIP, Central Public Health Lab., London (England). Communicable Disease Surveillance Centre. M. C. O'Mahony, N. D. Noah, B. Evans, D. Harper, and B. Rowe.
The Journal of Hygiene JOHYAY, Vol. 97, No. 2, p 229-236, October 1986. 1 fig. 2 tab, 4 ref.

Descriptors: *Drinking water, *Water pollution sources, *Gastroenteritis, *Escherichia coli, *Public health, *Pollutant identification, *Epidemics, *Coliforms, *Water pollution effects, Bacteria, Water storage, Wastewater, Pollutants, Sublethal effects, Water supply, Domestic water.

In an outbreak of gastroenteritis on board a cruise ship 251 passengers and 51 crew were affected and consulted the ship's surgeon during a 14-day period. There was a significant association between consumption of cabin tap water and reported illness in passengers. Enterotoxigenic Escherichia coli were isolated from passengers and crew and coliforms were found in the main water storage tank. Contamination of inadequately chlorinated water by sewage was the most likely source of infection. A low level of reported illness and late recognition of the outbreak delayed investigation of what was probably the latest in a series of outbreaks of gastrointestinal illness on board this ship. There is a need for a national surveillance program which would monitor the extent of illness on board passenger cruise ships as well as a standard approach to the action taken when levels of reported illness rise above a defined level. (Author's abstract) thor's abstract) W87-04987

SALMONELLOSIS IN TWO DAIRY HERDS ASSOCIATED WITH A SEWAGE FARM AND WATER RECLAMATION PLANT,

Ministry of Agriculture, Fisheries and Food, Loughborough (England). Veterinary Investiga-tion Centre. F. G. Clegg, C. Wray, A. L. Duncan, and W. T.

Appleyard.
The Journal of Hygiene JOHYAY, Vol. 97, No. 2, p 237-246, October 1986. 1 fig, 3 tab, 12 ref.

Descriptors: *Land disposal, *Water pollution effects, *Pollutant identification, *Waste disposal, *Sludge utilization, *Public health, *Salmonella, *Bacteria, *Dairy industry, Wastewater, Sewage bacteria, Infection, Diseases, Pathology, Agriculture, Environmental effects.

Two dairy herds, situated on a sewage farm, were monitored for the presence of salmonellas following outbreaks of Salmonella dublin infection. In addition a S. dublin control scheme, which involved examination of adult animals and calf vaccing the salmone of th would be a common to scheme, which involved examination of adult animals and calf vaccination, was instigated. During the period 1975-84, 12 salmonells serotypes and 10 phage types of S. typhimurium were isolated from the cattle and their environment although their presence was seldom associated with diseases. Two adult S. dublin excreters were detected but it was concluded that none of the tests employed to examine the adult animals was sensitive enough. The prevalence of disease in the calves was low and although vaccination may have been beneficial it did not eradicate S. dublin infection. Thus S. dublin persisted in adults and calves during the 8-year period but its presence was seldom associated with disease. The results are discussed with regard to the disease risk to animals from the agricultural use of sewage aludge and the public health aspects. (Author's abstract) thor's abstract) W87-04988

TBT: AN ENVIRONMENTAL DILEMMA, Scripps Institution of Oceanography, La Jolla, CA. E. D. Goldberg. Environment ENTVAR, Vol. 28, No. 8, p 17-Environment ENTVAK, Vol. 20, 20,42-44, October 1986. 1 tab, 10 ref.

Descriptors: *Water pollution sources, *Ships, *Antifouling agents, *Heavy metals, *Tributyl tin compounds, *Environmental quality, *Water pollution effects, *Algicides, *Barnacles, Toxicity, Surface sealing, Algae, Crustaceans, Algal control, Pollutants, Toxins, Pesticides.

Tributyl tin (TBT) compounds are extremely toxic chemicals which were devised as antifouling agents for inclusion in paints to protect the surfaces of ships and other marine structures from the growth of marine organisms. When algae and barnacles accumulate on the bottoms of vessels, the drag is increased which, in turn increases fuel consumption. Use of TBT compounds results in economic savings in fossil fuel and maintenance, but it also causes the loss of indigenous organisms from marinas, harbors, and adjacent waters and the destruction of commercially grown oysters. French and English solutions to the dilemma were presented along with the results of TBT monitor-

ing studies in coastal waters of the U.S.A. and Canada. A comparison was drawn between TBT and DDT and regulatory options were suggested based on those established for DDT. (Wood-PTT) W37-04996

ECOLOGY OF SCENEDESMUS BLOOMS, Osmania Univ., Hyderabad (India). Dept. of Botany. For primary bibliographic entry see Field 2H. W87-04999

EICHHORNIA CRASSIPES (MART) SOLMS IN RELATION TO PH, Regional Research Lab., Hyderabad (India). Biocontrol Unit. K. Jamil, M. Z. Jamil, P. V. R. Rao, and G.

Thyagarajan. Indian Journal of Botany IJBODX, Vol. 8, No. 2, p 156-158, December 1985. 1 tab, 5 ref.

Descriptors: *Plant physiology, *Water hyacinths, *Heavy metals, *Hydrogen ion concentration, *Detoxification, *Decontamination, *Neutralization, *Water pollution effects, *Water pollution control, Pollutants, Lakes, Streams.

The ability of water hyacinths to absorb heavy metals from aquatic medium was reported earlier. The plant is also able to adjust itself to withstand the effect of pH changes in the aquatic environment. The remarkable ability of the plant to neutralize some very acidic solutions is found in the case of copper, cadmium and zinc solutions, however, it could not neutralize iron solutions and developed visible symptoms of physiological imbalance and finally died. These results suggest that the water hyacinth could be selectively employed to detoxify lakes and streams. (Author's abstract) W87-05001

MODELLING THE FATE OF MIREX AND LINDANE IN LAKE ONTARIO, OFF THE NI-AGARA RIVER MOUTH, National Water Research Inst., Burlington (Ontar-io). Environmental Simulation Section. For primary bibliographic entry see Field 5B. W87-05002

EFFECTS OF SIMULATED ACID RAIN ON GERMINATIVE CAPACITY, GROWTH AND MORPHOLOGY OF FOREST TREE SEED-

es Forest Research Centre. Fredericton Maritin Martinies Porest Research Centre, Fredericton (New Brunswick). K. Percy. New Phytologist NEPHAV, Vol. 104, No. 3, p 473-484, November 1986. 1 fig, 9 tab, 28 ref.

Descriptors: "Water pollution effects, "Forests, "Simulated rainfall, "Pollutants, "Acid rain, "Germination, "Plant morphology, "Rainfall, Trees, Simulation, Conifers, Deciduous trees, Hydrogen ion concentration, Growth, Morphology, Seed-

Acid rain-induced direct injury to forest tree seedlings was investigated in specially designed controlled-environment simulated-rainfall chambers. Seed germinative capacity, seedling survival, seedling growth and morphological responses to simulated rains of pH 5.6, 4.6, 3.6 and 2.6 were examined during the first growth cycle in 11 commercially important north temperate tree species. Germinative capacity was weakly responsive to rain pH, while seedling survival was more sensitive. No evidence of macroscopic foliar injury was observed at rain pH > 2.6. Treatment with pH < one with the photograph of Acid rain-induced direct injury to forest tree seedW87-05008

EFFECTS OF CHEMICALLY CONTAMINAT-ED SEWAGE SLUDGE ON AN APHID POPU-LATION

LATION, Cornell Univ., Ithaca, NY. Dept. of Entomology. T. W. Culliney, and D. Pimentel. Ecology ECOLAR, Vol. 67, No. 6, p 1665-1669, December 1986. 2 fig, 1 tab, 55 ref. EPA Grant

Descriptors: *Path of Pollutants, *Sludge disposal, *Aphids, *Ecological effects, Contaminants, Nutrition, Toxicity, Agriculture, Demography, Environmental effects, New York, Pollutants, Insects, Sludge, Survival, Reproduction, Diets, Population expo

exposure.

Survival and fecundity of green peach aphids, Myzus persicae, were markedly reduced when they were fed on collard plants grown in pots of soil treated with chemically contaminated sewage sludge, as compared to populations on potted plants grown in uncontaminated sludge or on fertilized soil (control). Calculated demographic parameters differed significantly between the contaminated sludge populations and between the contaminated sludge and control populations. No significant differences were detected between the uncontaminated sludge and control populations. The ecological effects on the aphids suggest that plant uptake and translocation of chemicals from the contaminated sludge affected aphid fitness through direct toxicity and/or reduced nutritional value of the plant. The results indicate that phytophagous insects may be affected by chemical contaminants in sewage sludge used in agriculture. (Author's abstract) W87-05009

URINARY MUTAGENS IN MUNICIPAL SEWAGE WORKERS AND WATER TREAT-MENT WORKERS AND WATER TREAT-MENT WORKERS, New York State Coll. of Veterinary Medicine, Ithaca.

J. M. Scarlett-Kranz, J. G. Babish, D. Strickland, R. M. Goodrich, and D. J. Lisk. American Journal of Epidemiology AJEPAS, Vol. 124, No. 6, p 884-893, December 1986. 5 tab, 42

Descriptors: "Water pollution effects, "Mutagens, "Fate of pollutants, "Wastewater treatment personnel, "Water treatment personnel, "Occupational exposure, "Urine, "Ames test, Enzymes, Public health, Epidemiology, New York, Population exposure."

About 60,000 chemicals are presently in use in the United States, and an additional 700 to 1,000 are introduced into commerce annually. A considerable portion of these chemicals are flushed as residuals into sewage treatment plants. Tunically, in introduced into commerce annually. A considerable portion of these chemicals are flushed as residuals into sewage treatment plants. Typically, in large cities, well over 100-200 industries may be served by a single sewage treatment plant. Therefore, a virtual galaxy of chemicals may be present in a single sludge. In view of the potential exposure of sewage treatment workers to a multitude of mutagenic substances, the frequency of urinary mutagens was measured by the Ames test among a sample of 164 sewage treatment workers employed in 14 sewage treatment plants which processed between 3 and 10 million gallons of sewage daily in New York State between March and July, 1984. The frequency was compared to that observed in 72 water treatment employees in the same municipalities. Sewage workers had a significantly higher risk for urinary mutagens after controlling for smoking, using the Ames test, both with and without the addition of the liver microsomal homogenate, S-9. More precise methods of measuring exposure in epidemiologic studies, particularly in environmental and occupational epidemiology, are in various stages of development. (Alexander-PTT) PTT) W87-05027

OUTBREAK OF STAPHYLOCOCCAL SKIN IN-FECTIONS AMONG RIVER RAFTING RAFTING

Centers for Disease Control, Atlanta, GA. Div. of Field Services.
M. D. Decker, J. A. Lybarger, W. K. Vaughn, R. H. Hutcheson, and W. Schaffner.
American Journal of Epidemiology AJEPAS, Vol. 124, No. 6, p 969-976, December 1986. 1 fig. 2 tab,

Descriptors: *River rafting guides, *Skin infections, *Staphylococcus, *Epidemics, *Occupational exposure, *Water pollution effects, *Recreation, Case studies, Immersion, Human diseases.

Outbreaks of staphylococcal skin infections amon bealthy adults are most unusual. The authors report an epidemic of skin infections due to Staphylococcus aureus that involved river rafting guides in Tennessee, South Carolina, and North Carolina in Tennessee, South Carolina, and North Carolina in summer 1982. Infections occurred only among employees of the rafting companies that provided communal, on-site housing; carriage rates of S. aureus were as high as 89% at those companies. A case-control study found that having had an infected roommate was significantly associated with infection, as was working at the livery with the most crowded housing. This outbreak appeared to be due to two factors: frequent minor skin wounds acquired while rafting, and prolonged close contact among the persons with wounds. It is likely that crowding and exposure to infected wounds led to elevated S. aureus carriage rates, which in turn increased the probability that wounds would become infected. Repeated immersion in water likely enhanced the development of infections. (Author's abstract) likely enhanced th (Author's abstract) W87-05028

BIOTOXICITY OF TRACE METALS AND COMPOSTED SLUDGE/MINERAL SUB-COMPOSTED SLUDGE/MINERAL SUB-STRATE INTERACTIONS, Ecole Polytechnique Federale de Lausanne (Swit-zerland). Dept. de Genie Rural et Geometre. For primary bibliographic entry see Field 5E. W87-05034

METAL ASSOCIATIONS IN ANOXIC SEDI-MENTS AND CHANGES FOLLOWING UPLAND DISPOSAL, Technische Univ. Hamburg-Harburg (Germany,

F.R.). For primary bibliographic entry see Field 5E. W87-05035

CADMIUM-INDUCED ACCUMULATION OF PUTRESCINE IN OAT AND BEAN LEAVES, Boyce Thompson Inst. for Plant Research, Ithaca,

N I.
L. H. Weinstein, R. Kaur-Sawhney, M. V. Rajam,
S. H. Wettlaufer, and A. W. Galston.
Plant Physiology PLPHAY, Vol. 82, No. 3, p 641645, November 1986. 4 tab, 23 ref.

Descriptors: *Cadmium, *Bioaccumulation, *Oats, *Beans, *Putrescine, *Water pollution effects, Enzymes, Plant physiology, Wilting, Water stress, Accumulation, Nitrogen compounds, Solubility.

Cadmium is an important environmental contaminant, not only because of its phytotoxicity, but also because its uptake and accumulation in plants may introduce it into the food chain. Cd is emitted to occause its uprace and accumulation in plants may introduce it into the food chain. Cd is emitted to the atmosphere from coal-fired power plants, steel mills, metal smelting and roasting operations, incineration of wastes, and electroplating processes. The effects of Cd (2+) on putrescine (Ppt), spermidine (Spd), and spermine (Spm) titers were studied in oat and bean leaves. Treatment with Cd(2+) for up to 16 hours in the light or dark resulted in a large increase in Put titer, but had little or no effect on Spd or Spm. The activity of arginine decarboxylase (ADC) followed the pattern of Put accumulation, and experiments with alpha-difluoromethylarginine established that ADC was the enzyme responsible for Put increase. Concentrations of Cd(2+) as low as 10 micromolar increased Put titer in oat segments. In bean leaves, there was a Cd(2+)-induced accumulation of Put in the free and soluble conjugated fractions, but not in the insoluble fraction. This suggests a rapid exchange between Put that exists in the free form and Put

found in acid soluble conjugated forms. It is concluded that Cd(2+) can act like certain other stresses (K(+) and Mg(2+)deficiency, excess NH4(+), low pH, salimity, osmotic stress, wilting) to induce substantial increases in Put in plant cells. (Alexander-PTT) W87-05036

REDUCTION OF POPULATION GROWTH IN TISBE HOLOTHURIAE HUMES (COPEPODA: HARPACTICOIDA) EXPOSED TO LOW CADMIUM CONCENTRATIONS, Victoria Ministry for Conservation, Queenscliff (Australia). Marine Science Labs. G. W. Brand, G. J. Fabris, and G. H. Arnott. Australian Journal of Marine and Freshwater Research AJMFA4, Vol. 37, No. 4, p 475-479, 1986. 2 tab. 16 ref.

Descriptors: *Copepods, *Population dynamics, *Cadmium, *Water pollution effects, *Reproduction, Comparison studies, Heavy metals, Toxicity, Larvae, Harpacticoids.

Metals released into coastal waters tend to accumulate in sediments, where they may become biologically available through particle ingestion and mobilization into the surrounding water. The organisms most in jeopardy from metal discharges are those inhabiting sediments, benthic macroalgae, and other substrata, in areas of particle deposition. Among the metazoans inhabiting sediments and phytal environments, harpacticoid copepods are of particular importance in terms of their numerical abundance and their contribution to the diet of many larval and juvenile fish. Their response to low levels of toxic metals is therefore a matter for concern. Replicate laboratory populations of T. holothuriae initiated by founder females standardized in terms of reproductive status, age and environmental background were exposed to three levels of cadmium for 24 days and compared with untreated controls. At a cadmium concentration of 159 microgram(ug)/L. populations failed to increase and became virtually extinct, probably because of larval impairment. At concentrations of 2.3 and 40 ug/L population growth occurred but total population jaye findes plus founds. Metals released into coastal waters tend to accu cause of larval impairment. At concentrations of 2.3 and 40 ug/L population growth occurred but total population size (males plus females plus copepodids) and both male and female numbers were significantly reduced relative to controls. Knowledge of the response of harpacticoids to low levels of toxic metals therefore appears to be significant in developing an understanding of the effects of metals on marine ecosystems. (Alexander-PTT) W87-05042

ARSENITE TOXICITY AND ARSENITE TOL-ERANCE IN THE CYANOBACTERIUM SYNE-CHOCOCCUS LEOPOLIENSIS, Queen's Univ., Kingston (Ontario). Dept. of Biol-

ogy. K. Budd, J. R. Casey, and J. D. MacArthur. Canadian Journal of Botany CJBOAW, Vol. 64, No. 11, p 2433-2440, November 1986. 3 fig, 7 tab, 42 ref.

Descriptors: *Arsenic compounds, *Water pollu-tion effects, *Cyanobacteria, Tolerance, Cultures, Photosynthesis, Cells, Growth, Inhibition, Toxici-ty, Enzymes, Amino acids, Heavy metals, Arsenic.

Mobilization of arsenic in the environment takes pace by natural processes (such as weathering of arsenic-containing rocks and vulcanism) and also as a result of human activities, notably industrial processes among which the smelting of nonferrous metals and the combustion of coal act as major sources of mobilized arsenic. Sodium arsenite at concentrations above 50 micro(u)M inhibited the respect of Superchocous legonities; 171794 698 concentrations above 50 micro(u)M inhibited the growth of Synechococcus leopoliensis UTEX 625 in a defined culture medium. Inhibition was transitory, with growth resuming after a lag period the duration of which depended on the arsenite concentration. Cells grown for several hours in the presence of 10uM arsenite became tolerant to concentrations of arsenite that inhibited the growth of untreated cells. Neither sensitive nor tolerant cells chemically modified the external arsenite detectably within the experimental period. At a concentration of 200 uM, arsenite temporarily halted growth of sensitive cells but did not affect that of

Group 5C-Effects Of Pollution

tolerant cells. This concentration of arsenite inhibited net photosynthesis in both sensitive and tolerant cells. At the same time it selectively decreased the incorporation of carbon in the light into alphamino acids, especially glutamate, in sensitive but not in tolerant cells. Simultaneously, incorporation of carbon into pyruvic acid markedly increased. The activity of the partially purified pyruvate dehydrogenase complex of S. leopoliensis was abolished by 45 uM arsenite. Inhibition of pyruvate dehydrogenase by arsenite is sufficient to explain its inhibition of growth in this organism. (Alexander-PTT)

IN-DEPTH SURVEY AND ASSESSMENT OF DEEP INJECTION WELLS USED TO DISPOSE OF HAZARDOUS WASTE - PRELIMINARY REPORT,

Environmental Protection Agency, Washington, DC. Office of Drinking Water. For primary bibliographic entry see Field 5E. W87-05076

EFFECTS OF URANIUM MILL TAILINGS ON GROUND WATER QUALITY: A HISTORICAL PERSPECTIVE,

Nuclear Regulatory Commission, Washington, DC. Div. of Waste Management. M. F. Weber, and W. L. Dam.

IN: Innovative Means of Dealing with Potential Sources of Ground Water Contamination. Pro-Sources of Cround water Contamination. Proceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegna, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 193-208, 7 fig. 1 tab, 22 ref.

Descriptors: *Uranium, *Mine wastes, *Ground-water pollution, *Groundwater quality, *History, *Mills, *Water pollution effects, Industrial wastes, Sulfates, Nitrates, Chlorides, Molybdenum, Seleni-um, Arsenic, Vanadium, Heavy metals, Radioiso-

Since the early 1940's, commercial mills throughout the US have processed uranium ores. The most voluminous wastes of the uranium milling process are the tailings and liquors used to slurry these tailings into disposal impoundments. Concerns about environmental quality and public health prompted regulatory agencies and mill operators to assess the effects of tailings disposal on surface water and groundwater quality. Based on analyses of the distribution of aqueous contaminants active and inactive tailings impoundments, contaminant species were classified into general categories depending on their abundance in the tailings and their mobility in hydrogeologic systems. Class I constituents are conservative species such as sulfate, nitrate, and chloride that are generally abundant in tailings and migrate at or about the same velocity as groundwater flow. Class II constituents include uranium, molybdenum, selenium, arsenic, and vanadium, which are abundant in tailings and relatively mobile in hydrogeologic systems. Class Since the early 1940's, commercial mills throughand vanadium, which are abundant in tailings and relatively mobile in hydrogeologic systems. Class III constituents include other heavy metals and chemical constituents, as well as radionuclides (excluding uranium). Exceptions to this constituent classification are recognized and necessitate site-specific assessments of contaminant transport and water quality impacts. The classification supports development of groundwater monitoring and corrective action programs. Historical perspectives about the mobility, transport, and fate of toxic constituents present in uranium mill tailings and their effects on groundwater quality are essential to effective waste management as environmental strategies shift emphasis from remedial to protective actions. (See also W87-05071) (Author's abstract) stract) W87-05081

MONITORING OF GROUND WATER CONTAMINATION FROM WASTE DISPOSAL WASTE DISPOSAL SITES IN ALBERTA, CANADA, Alberta Environment, Edmonton. For primary bibliographic entry see Field 5B. W87-05095

EFFECT OF IRRIGATED AGRICULTURE ON

EFFECT OF IRRIGATED AGRICULTURE ON UNDERLYING GROUNDWATER, Agricultural Research Service, Phoenix, AZ. Water Conservation Lab.

Water Conservation Lab.

H. Bouwer, R. S. Bowman, and R. C. Rice.

IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 13-20, 13 ref.

Descriptors: *Irrigation effects, *Groundwater pollution, *Water pollution effects, *Path of pollut-ants, Agricultural practices, Pesticides, Nitrates, Nitrogen, Fertilizers, Aldicarb, Groundwater movement, Percolation, Halogenated pesticides.

Long-term effects of irrigation on groundwater are extremely important, considering that there are 220 million ha of irrigated land in the world which leak salty deep percolation water with fertilizer and pesticide residues. In the western USA, the deep percolation water typically contains several thousand mg/L salt and 10-50 mg/L nitrate-nitrogen. Pesticide residues now found in groundwater below irrigated land are mainly the soluble, low molecular weight compounds like aldicarb and dibromochloropropane. Less soluble, higher molecular weight compounds are retarded in the vadose zone and could arrive later. It can take decades for deep percolation water to reach deep groundwatzone and could arrive later. It can take decades for deep percolation water to reach deep groundwater. A field method to evaluate deep percolation rates from water content profiles and tracer movement is being developed. The effect of gravel layers on bulk hydraulic properties of the medium and downward movement of water and solutes was studied in the laboratory. (See also W87-05100) (Author's abstract)

INFLUENCE OF IRRIGATION AND NITRO-GEN FERTILIZATION ON GROUNDWATER QUALITY,
Science and Education Administration, Lincoln,

NE
J. S. Schepers, K. D. Frank, and D. G. Watts.
IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the
XVIIIth General Assembly of the International
Union of Geodesy and Geophysics, Hamburg, FR
Germany, August, 1983. IAHS Publication No.
146. p 21-32, 3 fig, 3 tab, 21 ref.

Descriptors: *Irrigation effects, *Nitrogen compounds, *Fertilizers, *Groundwater quality, Water pollution effects, Nitrates, Groundwater pollution, Platte River, Nebraska, Corn, Irrigation practices.

Groundwater concentrations of nitrate-nitrogen (NO3-N) in the intensively irrigated areas of the central United States have increased several times over the past few decades at a number of locations. Average NO3-N concentrations in the groundwater of the Platte River Valley of Nebraska increased from 3 mg/L in 1950 to 18 mg/L in 1980. Nitrates in this groundwater are a potential source of N for loant growth when used for irrigation. Another source of plant-available N is mineralization of soil organic matter, particularly in these deep alluvial soils, which often contain over 0.3% total N. Failure to consider all sources of N available to plants can result in excess fertilization, with accelerated N leaching when rainfall or irrigation exceeds plant water needs and soil moisture storage capacity. Improved N fertilization and irrigation practices from 1980 to 1982 on 3000 ha have reduced the average fertilizer N application by 94 kg N/ha/yr, with no significant reduction in maize (Zea mays L.) yield. (See also W87-05100) (Author's abstract) Groundwater concentrations of nitrate-nitros

DEGRADATION OF GROUNDWATER RE-SOURCES CAUSED BY INADVERTENT LAND MISUSE,

Geological Survey, Reston, VA.

W. Baca.
In: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International

Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 181-188, 2 tab, 10 ref.

Descriptors: *Groundwater pollution, *Degrada-tion, *Land use, *Groundwater depletion, Karst hydrology, Yucatan, Mexico, China, Ireland, Envi-ronmental policy, History.

Contamination, pollution, and depletion of ground-water are not new environmental problems brought on by the industrial revolution; archaeological and historical evidence can be interpreted to show that some early people brought an end to their civilizations by the misuse of their natural resources. Groundwater contamination is not an isolated problem, but is one part of the total environmental problem. As examples, three karst areas are referred to: one in the Yucatan of Mexico and another in China, both tropical, and one in Ireland, a temperate climate, with a terrain that has been glaciated. All three areas are similar to karst regions in other parts of the world in that they are afflicted with serious environmental problems. Karst environments are vulnerable and extreme care must be used to avoid damage. Experience Karst environments are vulnerable and extreme care must be used to avoid damage. Experience gained from these fragile environments can be transferred to slowly degraded terrains as a guide for more effective long-term development and preservation. Examples show how the people, particularly early people, contaminated their water in the Yucstan, destroyed the quantity and quality of water resources in western Ireland, and inadvertently degraded a small karst aquifer in China during modern times. (See also W87-05100) (Lantz-PTT) W87-05116

ASSESSMENT OF COAL TAR CONSTITUENTS ASSESSMENT OF COLL TAR CONSTITUENTS
MIGRATION: IMPACTS ON SOILS, GROUND
WATER AND SURFACE WATER,
Northeast Utilities Service Co., Hartford, CT.
E. J. Quinn, T. N. Wasielewski, and H. L.

Conway.

N. Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 111-127, 2 fig, 4 tab, 2 ref.

Descriptors: *Coal tar, *Path of pollutants, *Water pollution effects, *Groundwater pollution, Surface water, Polyaromatic hydrocarbons, *Aquifers, Naphthalene, Methylnaphthalene, Acenaphthylene, Groundwater movement, Vertical distributions

An investigation at a former coal gasification plant in central Connecticut was conducted to determine the effects of residual coal tar deposits on ground-water and surface water quality. The investigation had three aspects: (1) definenting the coal tar deposits, (2) defining the concentrations of the tar constituents at the source, and (3) determining their lateral and vertical distribution in the ground-water and their impact on a downgradient river. An important consideration was the mobility of the constituents given their various capacities to disselve and the constituents given their various capacities to disselve and the constituents given their various capacities to disselve and the constituents given their various capacities to disselve and the constituents given their various capacities to disselve and the constituents given their various capacities to disselve and the constituents given their various capacities to disselve and the constituents given their various capacities to disselve and the constituents given their various capacities to disselve and the constituents given their various capacities to disselve and the constituents given their various capacities to disselve and the constituents given their various capacities to disselve and the constituents given their various capacities to disselve and the constituents given their various capacities to disselve and the constituents given th An important consideration was the mobility of the constituents given their various capacities to dissolve and sorb. Geophysical techniques were used to delineate the coal tar deposits. A hydrologic study was then designed to determine the general direction and rate of groundwater movement and the distribution of contaminants throughout the aquifer. Ninety volatile and semivolatile priority pollutants and twenty-eight metals were analyzed in both soil and filtered groundwater samples. Major organic contaminants detected in the tar pond were polyaromatic hydrocarbons (PAHs), Major organic contaminants detected in the tar pond were polyaromatic hydrocarbons (PAHa), particularly naphthalene, methylnaphthalene, and accnaphthalene; these contaminants were found in decreasing concentration along the groundwater flow path. Contaminant distributions were found to be a function of lateral groundwater flow, the vertical component of groundwater movement and the chemical/physical nature of the coal tar com-ponents. Highly soluble, low molecular weight components were detected throughout the aquifer at varying depths and distances from the deposits. The groundwater flow paths show that the water movement is generally toward a downgradient river which acts as the principal discharge point

Waste Treatment Processes—Group 5D

for the groundwater at the site. No detectable concentrations of coal tar contaminants were found in the river's water column but several PAHs were detected in the sediments. (See also W87-05128) (Author's abstract)

5D. Waste Treatment Processes

BIO-CONVERSION OF ACCUMULATED SLUDGE WITH BACTERIAL AUGMENTATION PROCESS IN AERATED LAGOONS FOR MUNICIPAL WASTEWATER TREATMENT, Cleveland State Univ., OH. Dept. of Civil Engi-

Y.-T. Hung, F. L. Horsfall, J. M. Wong, and D. R.

Coker.
International Journal of Environmental Studies
IJEVAW, Vol. 28, No. 1, p 41-56, 1986. 10 fig. 5
tab, 10 ref.

Descriptors: "Sludge, "Biological wastewater treatment, "Wastewater treatment, "Municipal wastewater, "Aerated lagoons, "Biological oxidation, "Sludge digestion, Lagoons, Bacteria, Bacilus, Pseudomonas, Aerobacter, Sewage bacteria, Soil bacteria, Oxidation, Effluents, Cultures, Energy, Odor Control.

Energy, Odor Control.

The feasibility of using a bacterial augmentation process with a bacterial culture product (LLMO) addition in the bio-oxidation of accumulated sludges in aerated lagoons was determined in a municipal wastewater treatment plant in Greenville, SC. LLMO was added to the influent to the roughing filter at a dosage of 1 mg/1 to enhance the bio-conversion of settled sludge. Sludge profile measurements were taken prior to and after LLMO addition. The LLMO contained seven strains of bacteria commonly found in soils and in wastewater treatment plants. The lagoons had an accumulated sludge of 6.7 million pounds prior to the study period. During the eight-month study, 5.03 million pounds of sludge was removed by bio-oxidation, equivalent to a removal of 18,600 lbs soild/day or 20,000 to 30,000 lbs BoDV/day. There was no deterioration in final effluent quality in terms of such promistion, indicators as BOD or solid/day or 20,000 to 30,000 lbs BOD/day. There was no deterioration in final effluent quality in terms of such population indicators as BOD or TSS. Sludge blanket depth was reduced from 7-8 feet to 2-3 feet. Other benefits observed included energy saving and odor control. It is concluded that bacterial augmentation with LLMO addition enhanced bio-conversion of accumulated sludge in the secreted largoons without education. the aerated lagoons without adversely affecting final effluent quality. (Author's abstract)

ANAEROBIC TREATMENT OF BEET WASTE IN A STATIONARY FIXED-FILM REACTOR, National Research Council of Canada, Ottawa (Ontario). Div. of Biological Sciences.

M. F. Hamoda, and K. J. Kennedy.
Agricultural Wastes AGWADL, Vol. 17, No. 3, p

Agricultural Wastes AGWADL, 175-187, 1986. 6 fig, 2 tab, 12 ref.

Descriptors: *Wastewater treatment, *Pollution load, *Industrial waste, *Beet waste, *Stationary fixed-film reactors, *Anaerobic digestion, *Biological wastewater treatment, *Organic loading, *Chemical oxygen demand, Methane, Biomass.

*Chemical oxygen demand, Methane, Biomass.

Laboratory scale, downflow stationary fixed-film reactors, with polyester cloth support and a surface-to-volume ratio of 86 sq m/cu m, and operated continuously at 35 C, were capable of treating red beet wastewater with an organic strength between 5000 and 15000 mg chemical oxygen demand (COD)/iter, at up to 87% COD removal efficiency. Organic loadings of up to 24 kg COD/cu m/day were achieved with COD removal rates of up to 16 kg COD/cu m/day and methane production rates exceeding 4 cu m/cu m (reactor volume)/day. Loading of 30 kg COD/cu m/day and hydraulic retention times of 5 hr were achieved without process failure. The actual amount of waste organics converted and methane gas produced increased with increased loading, even though COD removal efficiencies decreased. A wide range of waste organic strengths could readily be treated, but maximum methane produc-

tion and COD conversion rates would be achieved with increased waste organic strength. Biomass yield increased with increased organic loading and was slightly influenced by waste organic strength. stract)

FIXATION AND SOLIDIFICATION OF For primary bibliographic entry see Field 5E. W87-04369

ANTIBIOTIC RESISTANCE AND TRANSFER-ABLE RESISTANCE IN ENTEROBACTERIA-CEAE IN MUNICIPAL WASTE WATERS, Vyskumny Ustav Preventivneho Lekarstva, Bratis-lava (Czechoslovakia). For primary bibliographic entry see Field 5A. W87-04377

WASTEWATER RENOVATION IN A SLASH PINE PLANTATION SUBJECTED TO PRE-SCRIBED BURNING, Georgia Univ., Athens. School of Forest Re-

For primary bibliographic entry see Field 5E. W87-04447

BACTERIAL COMMUNITIES DEGRADING AMINO- AND HYDROXYNAPHTHALENE-2-SULFONATES, Gesamthochschule Wuppertal (Germany, F.R.). Lehrstuhl fuer Chemische Mikrogiologie. For primary bibliographic entry see Field 5B. W87-04465

DEWATERABILITY OF MUNICIPAL SLUDGES 1: A COMPARATIVE STUDY OF SPECIFIC RESISTANCE TO FILTRATION AND CAPILLARY SUCTION TIME AS DEWATERABILITY PARAMETERS, National Inst. for Water Research, Bellville (South

Africa). Cape Regional Lab. M. Smollen. Water S. A. WASADV, Vol. 12, No. 3, p 127-132, July 1986. 6 fig, 7 tab, 11 ref.

Descriptors: *Municipal wastewater treatment, *Anaerobic digestion, *Sludge drying, *Dewatering, *Filtration, Wastewater treatment, Zimpro

process, South Africa

The parameters specific resistance to filtration (SRF) and capillary suction time (CST) are used to compare the relative dewatering properties of six categories of municipal sludge from eleven municipal wastewater treatment plants throughout South Africa. Anaerobically digested mixtures of primary and waste activated sludges display the poorest dewatering characteristics (SRF range 138-260 x 10 to the twelfth power m/kg, CST range 152-860 sec), while sludge heated by the Zimpro process is recorded to have the best dewatering properties. (SRF 0.1-1.4 x 10 to the twelfth power m/kg, CST 9-16 sec), (See also W87-04483) (Airone-PTT) W87-04482

DEWATERABILITY DEWAIERABILITY OF MUNICIPAL SLUDGES 2: SLUDGE CHARACTERIZATION AND BEHAVIOUR IN TERMS OF SRF AND CST PARAMETERS, National Inst. for Water Research, Bellville (South

Africa). Cape Regional Lab. M. Smollen.

Water S. A. WASADV, Vol. 12, No. 3, p 133-138, July 1986. 9 fig, 3 tab, 10 ref.

Descriptors: *Municipal wastewater treatment, *Sludge drying, *Dewatering, *Filtration, *Wastewater treatment, South Africa.

Development of economic and more efficient sludge handling methods requires identification and understanding of the characteristics that control sludge dewatering behavior. This paper attempts to identify some of the main factors that might be responsible for the dewatering character-

istics of municipal aludges. The factors studied include solids concentration, particle distribution and behavior (especially blinding phenomena), and sludge compressibility. Two well known laboratory sludge characterization techniques were used, i.e. specific resistance to filtration (SRF) and capillary suction time (CST). The study indicated that the SRF provides greater opportunity for identifying and investigating these factors. By studying the deviations of the recorded behavior from that hypothesized in the SRF test it was found that the SRF parameter is a composite of filtration, blinding, and compression characteristics. (See also W87-04482) (Airone-PTT)

BIOLOGICAL PROCESS FOR SULPHATE RE-MOVAL FROM INDUSTRIAL EFFLUENTS,

J. P. Maree, A. Gerber, and W. F. Strydom. Water S. A. WASADV, Vol.12, No. 3, p 139-144, July 1986. 3 fig, 5 tab, 10 ref.

Descriptors: *Heavy metals, *Water reuse, *Biological wastewater treatment, *Effluents, *Sulfate removal, *Anaerobic digestion, *Calcium sulfate, Mining industry, Phenols, Sulfur, Molasses.

A biological process comprising anaerobic, stripping and aerobic stages is described for the treatment of effluents containing excessive amounts of calcium sulphate and high concentrations of heavy calcium sulphate and high concentrations of heavy metals. By using molasses as carbon source in an upflow anaerobic packed bed reactor, sulfate was reduced to hydrogen sulfide, which precipitated heavy metals as the corresponding sulfides. The removal of the end products of the anaerobic stage, namely hydrogen sulfide, calcium carbonate, and soluble organic matter, was studied under batch conditions by applying air stripping, clarification, and aerobic treatment consecutively. Approxi-mately 90 per cent of the influent sulphate was removed at a hydraulic retention time of 10 h mately 90 per cent of the influent sulphate was removed at a hydraulic retention time of 10 h when 3 g molasses per 1 effluent was dosed. The final product was free of heavy metals and cyanide while the COD value of the effluent was 300 mg/l. The carbonaceous residual consisted of phenol which originates from the molasses, but which is harmless to most of the mining metallurgical proc-esses. One of the attractive features of the process is that sulfur may be recovered as a by-product from effluent purification. (Author's abstract) W87-04484

ANAEROBIC TREATMENT OF DOMESTIC WASTEWATER,

setts Univ., Amherst. Environmental En-

Massacausetts Univ., Amnerst. Environmental En-gineering Program.
M. S. Switzenbaum, and C.P. L. Grady.
Journal - Water Pollution Control Federation JWPFA5, Vol. 28, No. 2, p 102-106, February 1986. 11 ref. NSF Grant CEE-8413020.

Descriptors: *Anaerobic digestion, *Wastewater treatment, Anaerobic methane fermentation, Upflow anaerobic sludge blanket, Sludge, Cali.

Upflow anaerobic sludge blanket, Sludge, Cali.

Recent advances in both the fundamental and applied aspects of anaerobic methane fermentation have encouraged many researchers and practitioners to re-examine the role of this process in the treatment of domestic wastewater. In June 1985 a seminar-workshop was held at the University of Massachusetts, Amherst, to highlight the state-of-the-art of this subject and to provide the impetus for further research and development. The papers presented at this meeting fell into three general categories: overview-the application of anaerobic treatment processes for wastewater was reviewed and the benefits and problems described; experiences in temperate climates—pilot-scale testing of the upflow anaerobic sludge blanket (USAB) and fluidized-expanded-bed processes (UASB) were described; and experiences in tropical climates—the operation of a UASB pilot plant in Cali, Columbic, which treats raw domestic wastewater, was discussed. It was concluded that anaerobic treatment has the potential to treat low strength wastewaters. (David-PTT) W87-04525

Group 5D—Waste Treatment Processes

DEVELOPMENT OF BIOFILM, OPERATING CHARACTERISTICS AND OPERATIONAL CONTROL IN THE ANAEROBIC ROTATING RIOLOGICAL CONTACTOR PROCESS, Dynatech R/D Co., Cambridge, MA.
M. J. Laquidara, F. C. Blanc, and J. C.
O'Shaunbassay.

O'Shaughnessy.

Journal - Water Pollution Control Federation
JWPFA5, Vol. 58, No. 2, p 107-114, February
1986. 18 fig. 5 tab, 12 ref.

Descriptors: *Anaerobic rotating biological contactor process, *Anaerobic digestion, *Biofilms, *Wastewater treatment, *Biological wastewater, *Fized-film anaerobic process, Organic remover, Fized-film systems, Organic loading, treatment, Methane, Chemical oxygen demand, Carbohydrates, Colloids, Effinents.

The development of design information for an anaerobic rotating biological contactor (AnRBC) process with respect to biofilm attachment patterns, organic removal efficiencies, solids production rates and gas quality and volumes were the objectives of the study. For this research two pilot-scale AnRBC units were used and housed in a temperature-controlled room set at 35 degrees. The AnRBC process proved to be an effective process for treating a carbohydrate waste. Based on soluble COD maximum organic removal was 92% at low application rates. Even at application rates near the rate-limiting mass loading rate, there was only a 5 to 7% loss in efficiency. In addition, the AnRBC system performance was not as adversely affected by hydraulic overloads as were other anaerobic treatment processes. (David-PTT)

MEDIA DESIGN FACTORS FOR FIXED-RED

FILTERS, Arkansas Univ., Fayetteville. Dept. of Civil Engi-

neering.
K. H. Song, and J. C. Young.
Journal - Water Pollution Control Federation
JWFFA-5, Vol. 58, No. 2, p 115-121, February
1986. 9 fig. 10 tab, 4 ref. EPA Research grant
R810528-010.

Descriptors: *Filter media, *Surface area, *Fixed-bed anaerobic filters, *Wastewater treatment, An-aerobic filters, Fixed-bed filters, Organic wastes, Sludge, Biological wastewater treatment, Chemical

The factors that cause waste treatment performance and operating characteristics to vary for different media designs were studied. Four large laboratory-scale reactors were used. Each reactor was 0.15 m in diameter and 1.83 m tall. Water was pumped through a water jacket surrounding each reactor to control temperature, and the units were operated in an upflow mode. The findings of this research included: within a given physical media configuration, the performance of upflow anaerobic filters was ony slightly affected by the specific surface area of media; cross-flow media provided much greater COD removal than did tubular media with the same specific surface area; the slope of the interstitial channels within a cross-flow media significantly affected COD removal performance; and the potential of plugging a corrugatformance; and the potential of plugging a corrugat-ed modular media is related to the slope of the interstitial channels and the size of the openings.

ANAEROBIC TREATMENT OF COAL CON-VERSION WASTEWATER CONSTITUENTS: BIODEGRADABILITY AND TOXICITY, Drexel Univ., Philadelphia, PA. Environmental

Studies Inst.
D. J. W. Blum, R. Hergenroeder, G. F. Parkin,

Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 2, p 122-131, February 1986. 6 fig. 6 tab. 19 ref. EPA Grant R80310.

Descriptors: *Anaerobic methane fermentation, *Biodegradation, *Coal conversion wastewaters, *Toxicity, *Wastewater treatment, *Anaerobic digestion, Aerobic biodegration, Aerob

logical treatment, Phenols, Industrial wastewater, Chemical oxygen demand, Organic compounds, Municipal wastewater, Retention time, Acclimati-

The biodegradability and toxicity of coal conversion wastewater (CCWW) constituents in anaerobic cultures was studied with proper attention to acclimation and solids retention time. The serum bottle studies conducted for this research were the biochemical Methane Potential (BMP), and the biochemical Methane Potential (BMP), and the Anarobic Toxicity Assay (ATA). In the BMP studies, 150-mL bottles were washed and purged with carbon dioxide and nitrogen gases. A seed culture and a known concentration of a CCWW constituent were introduced anaerobically. Triplicates of each test bottle and several controls without the CCWW constituent addition were kept Gas production from all bottles was measured periodically. The findings revealed differences in the ability of different anaerobic studges and cultures to degrade other CCWW constituents. Acclimation of a culture to neprod did not improve its to degrade other CCWW constituents. Acclima-tion of a culture to phenol did not improve its ability to degrade CCWW constitutents. Anaero-bic filters were superior to batch serum bottle cultures because they were able to acclimate more quickly and to higher concentrations of phenolics. (David-PTT) W87-04528

ANAEROBIC DIGESTION OF SOLIDS CAP-TURED DURING PRIMARY EFFLUENT FIL-

Nolte (George S.) and Associates, Sacramento,

S. R. Dean, M. R. Matsumoto, A. S. Weber, and

G. Tchobanoglous.

Journal - Water Pollution Control Federation

JWPFA5, Vol. 58, No. 2, p 132-138, February

1986. 5 fig. 12 tab, 18 ref.

Descriptors: *Secondary wastewater treatment, *Primary effluent filtration, *Filtration, *Wastewater treatment, *Anaerobic digestion, Effuent filtration, Performance evaluation, Backwash, Sludge, *Effluents, Clarifiers, Sludge treatment, *Biological wastewater treatment, Solids, Volatile solids, Chemical oxygen demand, Volatile acids, Methane, Particle size, Fatty acids, Grease, Oil

A study was made to determine the feasibility of using anaerobic digestion as a treatment alternative for the backwash solids from primary effluent filtration (PEF) and to compare the digestibility of backwash solids to that of primary sludge. Primary and backwash solids were collected once a week. The typical initial solids concentrations for both sludges were 30,0000 to 45,000 mg/L. Knowing the total solids (TS) content, both sludges were diluted with deionized water to 25,000 mg/L. TS. The dilution was done on a batch basis such that each batch contained enough sludge to feed the digesters for 1 week. Both primary and backwash sludge were stabilized effectively by the anaerobic digestion process, but the differences in the composition of the two sludges led to slightly different results. The volatile solids (VS) and COD percentage reduction was greater in the digesters that resuits. The volatile solids (VS) and COD percentage reduction was greater in the digesters that treated primary sludge than in those that treated backwash sludge. However, the volume of digesters gas produced per kilogram of VS destroyed was considerably higher from the digesters that treated backwash solids. (David-PTT) W87-04529

EVALUATION OF BIOLOGICAL SLUDGE PROPERTIES INFLUENCING VOLUME RE-DUCTION, Oklahoma State Univ., Stillwater. School of Civil

Oktanoma state only, Stillwater, School of Civil Engineering. J. B. Barber, and J. N. Veenstra. Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 2, p 149-156, February 1986. 13 fig. 2 tab, 22 ref.

Descriptors: *Biological wastewater treatment, *Wastewater treatment, *Sludge, *Sludge thickening, Dewatering, Sludge drying, Sludge content, Wastewater, Volume index, Proteins, Carbohydrates, Heavy metals, Bound water.

Twenty-eight biological sludge samples were collected and analyzed. Of these, 23 were removed from full-scale municipal facilities and five were removed from bench-scale units. The single most removed from bench-scale units. The single most influential factor in gravitational thickening proved to be filament length. Also, the thickening characteristics of sludges collected from the bench-scale systems were usually independent of any trends exhibited by the municipal sludges. Also, no individual parameter gave as strong a correlation for dewatering, as did the filament length for thickening. In part, this may be attributed to the greater complexity of factors and processes involved in vacuum filtration. (David-PTT) W87-04531

ACCLIMATION AND BIODEGRADATION OF CHLORINATED ORGANIC COMPOUNDS IN THE PRESENCE OF ALTERNATE SUB-STRATES,

STRATES, Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering. C. J. Kim, and W. J. Maier. Journal - Water Pollution Control Federation JWPFA5, Vol. 58, No. 2, p 157-164, February 1986. 8 fig, 1 tab, 30 ref.

Descriptors: *Organochlorine compounds, *Organic compounds, *Chlorinated hydrocarbons, *Biodegradation, *Substrates, *Acclimatization, *Wastewater treatment, *Microbial degradation, Pseudomonas, Residual chlorine, Halogens, Degra-

Acclimation and biodegradation of chlorinated organic compounds were studied in the presence and absence of alternate substrates. Experiments were conducted in batch reactors and continuous-flow constant volume reactors. The flasks were shaken constant volume reactors. The flasks were shaken continuously on a shaker in a dark, 20 C constant-temperature room. This continuous shaking provided sufficient oxygen transfer to maintain aerobic conditions at all times. To provide for oxygen and mixing, chemostat reactors were sparged with air. Biodegradation tests with acclimated enrichment cultures revealed that they were capable of utilizing their target substrate over wide range of concentrations. When nutrient broth was added as an alternate substrate, concurrent substrate utilization occurred: the overall rate of chlorinated units of the control of the con an atternate substrate, concurrent substrate utiliza-tion occurred; the overall rate of chlorinated or-ganic substrate removal was enhanced except at low concentrations. (David-PTT) W87-04522

REMOVAL OF PARTICULATE AND DIS-SOLVED ORGANICS IN AEROBIC FIXED-FILM BIOLOGICAL PROCESSES,

Lund Univ. (Sweden).

E. Sarner.

Journal - Water Pollution Control Federation
JWPFAS, Vol. 58, No. 2, p 165-172, February
1986. 10 fig. 1 tab, 26 ref.

Descriptors: *Dissolved solids, *Model studies, *Biological wastewater treatment, *Aerobic fixed-film process, *Wastewater treatment, *Aerobic treatment, Adsorption, Oxidation, Filtration, Municipal wastewater, Industrial wastewater, Wastewater, Sludge, Particulate matter, Biofilms, Biological oxygen demand, Trickling filters, Hy-draulic loading, Suspended solids, Organic matter, Chemical oxygen demand, Colloids, Effluents.

Chemical oxygen demand, Colloids, Effluents.

The mechanisms controlling particulate organics removal, and the possible interaction between dissolved and particulate organics were studied. Because the organic matter in most wastewaters consists of both particulate and dissolved organics, the total efficiency of a fixed-film biological process depended on the removal of both these factors. Also, the final treatment result depended on the efficiency of the separation process where the biological flocs were removed, especially if the biological process was the final treatment process. Unfortuantely, it would probably be impossible to develop a mathematical model to completely describe the trickling filter process because of its extreme complexity. Based on current available information, the organic and hydraulic load should be calculated per internal surface area and not per filter volume or horizontal filter area. Packages

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with higher specific surfaces could be used to obtain higher removal rates per filter volume and also a better effluent quality. (David-PTT)

TRACERS OF SEWAGE SLUDGE IN THE MARINE ENVIRONMENT: A REVIEW, Lancaster Univ., Bailrigg (England). Lancashire and Western Sea Fisheries Joint Committee. For primary bibliographic entry see Field 5B. W87-04565

REVIEW AND EVALUATION OF CURRENT DESIGN AND MANAGEMENT PRACTICES FOR LAND TREATMENT UNITS RECEIVING PETROLEUM WASTES, Utah Water Research Lab., Logan. J. P. Martin, R. C. Sims, and J. Matthews. Hazardous Waste and Hazardous Materials, Vol. 3. No. 3, p 261-280, 1986. 7 fig, 8 tab, 11 ref.

Descriptors: *Land disposal units, *Petroleum wastes, *Management practices, *Design standards, *Waste disposal, *Wastewater treatment, *Oil, Wastes, Engineering, Oil, Performance evaluation, Liquid wastes, Soild wastes, Semisolid wastes, Graphical methods, Mathematical studies, Design wastess.

Design matrices.

Land treatment practices used by petroleum waste land treatment facilities in the U. S. were described. Information obtained for thirteen full-scale land treatment facilities included types of waste reated, characterization of land treated wastes, waste application rates (loading rates), waste application frequencies, and management practices used at the treatment units. Engineering design matrices which illustrated the relationships among waste degradation rate, application frequency, and waste degradation rate, and the effect of these parameters on stabilized concentrations during the active life of a unit were developed. Waste degradation half-life and waste application frequency were observed to have greater influence in determining the stabilized weight percentage of oil in the treatment soil than waste application rate. A three-dimensional graph was developed as an example of how design matrices can be used as engineering/management aids for petroleum land treatment design and operation. Values predicted by the graph agreed well with results obtained for the U.S. facilities. (Wood-PTT) PTT W87-04581

NITROGEN TRANSFORMATIONS IN AN AERATED LAGOON TREATING PIGGERY WASTES, Manitoba Univ., Winnipeg. Dept. of Civil Engi-

Decring.

J. A. Oleszkiewicz.

Agricultural Wastes AGWADL, Vol. 16, No. 3, p. 171-181, 1986. 3 fig. 1 tab, 17 ref. EPA Project JB-

Descriptors: *Nitrogen removal, *Aerated lagoons, *Wastewater treatment, *Farm wastes, *Piggery wastes, *Water pollution effects, *Fate of pollutants, *Biodegradation, Effluents, Pollution load, Organic loading, Microorganisms, Nitrogen, Nitrobacter, Bacteria, Nitrification.

Nitrogen compounds are of great importance during the treatment of piggery wastes. The nitrogen may be a nutrient to be conserved when land disposal is planned, or it may have to be removed when surface water discharge is planned. Effluents from anaerobic lagoons were treated in two parallel aerated lagoons, at variable organic load and hydraulic residence time. The removal of total Kjeldahl nitrogen (TKN) was found to increase rapidly at higher TKN food to microorganisms (F/M) ratios. At BOD F/M ratios below 0.6 kg/kg/day nitrification manifested itself through accumulation of oxidized forms of nitrogen. The apparent decrease in denitrification, evidenced by nitrites and nitrates present at these loads, can be attributed to an inadequate supply of easily available carbon as electron donor. Accumulation of nitrites at lower loads (higher residence times) might have been due to free nitrous acid toxicity to

the Nitrobacter species. A maximum TKN removal of 50% was achieved at TKN F/M = 0.5, which corresponded to a BOD/TKN ratio of 3.4. (Alexander-PTT) W87-04624

ISOLATION OF AN ANAEROBIC BACTERIAL CONSORTIUM DEGRADING PHENOLIC COMPOUNDS - ASSAY IN SWINE WASTE, Institut Armand-Frappier, Laval (Quebec). Centre de Recherche en Bacteriologie.

R. Beaudet, J. G. Bisaillon, M. Ishaque, and M.

Agricultural Wastes AGWADL, Vol. 17, No. 2, p 131-140, 1986. 3 fig, 2 tab, 14 ref. CRSAQ (Canada) Project IAF-82-960.

Descriptors: *Anaerobic bacteria, *Biodegrada-tion, *Phenols, *Fate of pollutants, *Pollutant identification, *Water pollution effects, *Farm wastes, *Swine wastes, *Isolation, *Cultures, Ac-climation, Bacteria, Minerals, Nutrients, Organic compounds, Fermentation, Degradation

The intensification of pig production has increased the environmental problems associated with this industry, particularly in respect of offensive odors. A microbial culture able to degrade phenol and pcresol under anaerobic conditions was isolated from a mixture of swamp water, sewage sludge, swine waste and soil after an acclimation period of 5 weeks. The culture was enriched by periodic transfer in mineral salts medium containing phenol or pcresol as the sole source of carbon. After transfer in mineral salts medium containing phenol or p-cresol as the sole source of carbon. After several months of enrichment, the degradative activity of some cultures was lost. Addition of processe perpone to the minimal medium maintained the activity, whereas the addition of acetate, glucose of nitrate or the presence of ciliaries. the activity, whereas the addition of acetate, glu-cose or nitrate or the presence of silica gel as a solid matrix to hold the cells, had no effect. The degradation of the phenolic compounds appeared to be carried out via methanogenic fermentation by a bacteria consortium. Optimal degradation by the enriched culture was at pH between 7 and 8 and at 37 C. The bacterial culture was adapted to grow in swine waste and complete degradation of 100-120 mg/liter of phenolic compounds was obtained in swine waste seeded with this culture. (Alexander-PTT) PTT) W87-04627

TOTAL PHOSPHORUS ANALYSIS OF WASTEWATER SAMPLES USING THE STAN-NOUS CHLORIDE REDUCTION PROCE-

South Australia Engineering and Water Supply Dept., Salisbury. State Water Labs. For primary bibliographic entry see Field 5A. W87-04630

PREDICTING THE EXPANSION BEHAVIOR OF FILTER MEDIA, Bolton and Menk, Inc., Mankato, NM. For primary bibliographic entry see Field 5F. W87-04643

ACTION OF OZONE ON TROPHOZOITES AND FREE AMOEBA CYSTS, WHETHER PATHOGENIC OR NOT,

Trailigaz Co., Garges-les-Gonesse (France). search and Applications Div. For primary bibliographic entry see Field 5F. W87-04644 -Gonesse (France). Re-

ARE THE RESULTS OF OZONATION OF MODEL COMPOUNDS AT HIGH CONCEN-TRATIONS TRANSFERABLE TO THE CONDI-OF DRINKING WATER TREATMENT WITH OZONE.

zentrum Karlsruhe G.m.b.H. (Germany, F.R.). For primary bibliographic entry see Field 5F. W87-04645

IMPROVEMENT OF OZONE OXIDATION AND DISINFECTION DESIGN, Societe Degremont, Rueil-Malmai son (France).

For primary bibliographic entry see Field 5F. W87-04649

PURIFICATION OF PCB CONTAMINATED WATER BY CHITOSAN: A BIOLOGICAL TEST OF EFFICIENCY USING THE COMMON BARBEL, BARBUS BARBUS, Liege Univ. (Belgium). Lab. of Animal Morpholo-

gy.
Y. Van Daele, and J. P. Thome.
Bulletin of Environmental Contamination and
Toxicology BECTA6, Vol. 37, No. 6, p 858-865,
December 1986. 4 fig. 19 ref.

Descriptors: "Bioassay, "Wastewater treatment, "Bioindicators, "Bioaccumulation, "Polychlorinated biphenyls, "Chitosan, "Fish, "Barbel, Polymers, Water treatment, Industrial waste treatment,

Chitosan, the deacetylated form of chitin, a natural polymer, has been proposed for use in industrial applications for water purification. Adsorption capabilities of Chitosan towards highly chlorinated PCBs are discussed. The impact of that purification on the aquatic environment was tested by the analysis of the PCB accumulation in young specimens of the sensitive teleost Barbus barbus kept in PCB contaminated water filtered or unfiltered through chitosan. After filtration of contaminated water through chitosan, fish contamination always remained lower than 1 microgram(us)/g. These water through chitosan, fish contamination always remained lower than 1 microgram(ug)/g. These data do not differ significantly from control values obtained from 'clean' fish. Serious metabolic diseases have been reported when fish intoxication exceeded 1 microgram(ug)/g; below 1 microgram(ug)/g these symptoms did not occur. The results obtained suggested that filtration of PCB contaminated water through chitosan should be sufficient to protect fish from damaging intoxication. (Wood-PTT) W87-04666

USE OF SERUM ANTIBODY AS A MEANS TO DETERMINE INFECTIONS FROM EXPOSURE TO WASTEWATERS AND REFUSE, Cincinnati Univ., OH. Dept. of Environmental Health For primary bibliographic entry see Field 5A. W87-04668

REVIEW OF MODELS DEVELOPED TO PRE-DICT GASEOUS PHASE ACTIVATED CARBON ADSORPTION OF ORGANIC COM-POUNDS, Texas Univ. Health Science Center at San Anto-nio. School of Public Health

For primary bibliographic entry see Field 5F. W87-04669

PROGRAMMING A MINICOMPUTER FOR LIUQID LEVEL CONTROL IN A WATER TANK, Kuwait Univ., Safat. Coll. of Engineering and Pe-

For primary bibliographic entry see Field 5F. W87-04688

SLUDGE PROCESSING EFFECT ON COM-

POST QUALITY,
Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.

G. E. Fitzpatrick.
Biocycle BCYCDK, Vol. 27, No. 9, p 32, 34-35,
October 1986. 4 tab, 17 ref.

Descriptors: "Waste disposal, "Land application, "Water pollution effects, "Sludge disposal, "Sludge use, "Wastewater treatment, "Composting, "Plant growth, Horticulture, Dwarf schefflera, Spathiphyllum, Growth medium, Plant physiology, Cost analysis.

The suitability of two compost products for grow-ing dwarf schefflera and spathiphyllum was com-pared. The two products differed significantly in several characteristics: compost HC had grit re-moved, was a pure oxygen activated sludge, heat

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treated, and centrifuged, and had 26% solids (sterile dry cake), whereas compost PC was a conventional activated sludge, aerobically digested, with polymers added and dewatering on a belt press, and it had 18% solids (moist cake). By the end of a 26-wk production period, there highly significant differences in plant response. With both species, growth was best with HC and slowest with a conventional horticultural growing medium (CM). At 26 weeks dwarf scheffleras grown on HC were 6 wk ahead in growth of those grown on CM, and spathiphyllums on HC were 8 wk ahead. Growth of both on PC was intermediate. Physical and comomic analysis of the differences among the media if used to grow the spathiphyllum commercially in Florida are presented. (Rochester-PTT) W87-04800

QUALITY CONTROL MONITORING, East Bay Municipal Utility District, Oakland, CA. A. E. Greenberg, T. B. Shastid, and W. M. Ellgas. Biocycle BCYCDK, Vol. 27, No. 9, p 36-38, Octo-ber 1986. 2 fig, 2 tab, 2 ref.

Descriptors: *Quality control, *Waste disposal, *Composting, *Sludge disposal, *Wastewater treatment, East Bay, California, Temperature, Bacterial analysis, Cadmium, Lead, Nitrogen, Phosphorus, Coliforms, Nutrients.

Employment of quality control monitoring in the East Bay, California, municipal sludge composting program is described, with examples of results and how they are employed in management of the composting operation. Temperature, moisture and chemistry, and bacteriological analyses are conducted. Temperature analyses clearly illustrate a pile that failed to achieve thermophilic conditions, thus permitting it to be recycled. Chemical analyses demonstrate that the finished product meets standards for cadmium and lead, and that the compost contains significant N and P. Destruction of coliform bacteria is confirmed with the bacteriological analyses. (Rochester-PTT)

SLUDGE MANAGEMENT: A RESEARCH UPDATE: PART II, Weston (Roy F.), Inc., West Chester, PA. For primary bibliographic entry see Field 5E.

NEW SEWER IN ONE NIGHT: REPLACE-MENT WITHOUT EXCAVATION, For primary bibliographic entry see Field 8A. W87-04803

MEASURING SEWER SAG, South Stickney Sanitary District, Burbank, IL. For primary bibliographic entry see Field 7B. W87-0480.

OVERCOMING A SEWER MORATORIUM, C. Annis. Operations Forum, Vol. 3, No. 11, p 19-20, November 1986.

Descriptors: *Sewer infiltration, *Rehabilitation, *Pipes, *Sewerage, *Administrative decisions, Crossville, Tennessee, Pipe linings, Polyethylene, Construction, Maintenance.

The city of Crossville, Tennessee, recently was released from a state-imposed sewer connection moratorium after 7 yr. Completion of a new wastewater treatment facility did not eliminate the problem. In addition, it proved necessary to rehabilitate the collection system. A sewer system evaluation survey showed the locations of numerous inflow and infiltration problems throughout the system. Using these survey results, plus flow data and monitoring data, a plan for rehabilitation was developed. Due to the high expense of employing contractors, the city chose to buy its own alip liming equipment and to use city water and sewer maintenance crews to line the affected piping with polyethylene. As between 1983 and December

1985, slip lining of more than 50,000 linear feet of a total of 115,000 linear feet of sewer line has been lined and several hundred manholes have been repaired. Approximately 86% of the inflow and infiltration problem has been eliminated. (Rochester, PTT)

MICROSCOPIC EXAMINATION OF ACTIVAT-ED SLUDGE AND CONTROL OF AERATION

a Area Vocational-Technical School, KS. Salina Arcs - T. Hobson.
T. Hobson.
Operations Forum, Vol. 3, No. 11, p 22-27, November 1986. 9 fig.

Descriptors: *Sludge conditioning, *Pollutant identification, *Bioindicators, *Wastewater treatment, *Process control, *Protozoa, *Mixed liquor, *Microscopic analysis, *Wastewater treatment facilities, Ciliates, Flagellates, Bacteria, Sludge, Aerotics

ation.

Microscopic evaluation of sludge by enumeration of protozoa present is described in relation to the guidelines in the Water Pollution Control Federation's Manual of Practice No. 11, and steps to be taken to control the activated sludge process in response to what is found in sludge evaluation are described. Mixed liquor is examined for the presence of Sarcodina, holophytic flagellates, holozoic flagellates, free-swimming, crawling, and stalked ciliates, and rotifers, which can be identified easily with an inexpensive microscope. Because protozoa are more sensitive to process upsets than bacteria, a significant drop in the numbers of protozoa is usually the first indicator that the process is in trouble or soon will be. The three major activated sludge process controls available to operators are: control of aeration rates, control of sludge wasting rates, and control of return sludge flow rates. Various equipment for maintaining aeration is described and its operation discussed. (Rochester-PTT)

RECOMMENDATION FOR FLOOD DAMAGE REDUCTION AT WASTEWATER TREATMENT

a River Basin Commission, Harrisburg, PA

PA. S. K. Wright. Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 6, p 10-11, November-December 1986. 4 ref.

Descriptors: *Wastewater treatment facilities, *Floodproofing, *Surveys, National Flood Insurance Program, Management planning.

The findings of a survey of the flood preparedness of wastewater treatment plants are summarized and recommendations resulting from the survey are given. Most plants had no plans or, at best, poorly prepared plans for plant evacuation, temporary floodproofing, or other actions to reduce flood damage. Design of plants has not adequately considered flood vulnerability or actions to reduce damage in the event of flooding. Most wastewater treatment plants are ineligible for the National Flood Insurance Program because they do not meet the definition of being principally above ground. Early shutdown in anticipation of a flood, according to a written and tested plan, plant design that considers locating expensive machinery above the 100-yr flood, or even higher if feasible, alternatives to National Flood insurance, plant modifications to reduce damage, and plans for quick recovery after the flood are recommended. (Rochester-PTT) PŤT W87-04807

ACCURATE BOD DETERMINATIONS,

E. L. Stover. Water Pollution Control Association of Pennsylva-nia Magazine, Vol. 19, No. 6, p 18-20, November-December 1986. 3 fig.

Descriptors: *Wastewater treatment, *Effluents, *Water analysis, *Biological oxygen demand,

*Standards, *Monitoring, *Wastewater composi-tion, Dissolved oxygen.

The Standard Methods procedure for determining biochemical oxygen demand (BOD) of industrial wastewater or treated effluent is described and a modified procedure is explained, with presentation of guidelines for accurate BOD testing. The following general rules should reduce variability and increase confidence in test results: use acclimated seed material with complex wastewaters; inhibit nitrification when appropriate; determine seed demand and dilution water depletions with multiple dilutions; apply appropriate correction factors; demand and dilution water depletions with multiple dilutions; apply appropriate correction factors; select seed concentration to yield between 0.2 to 1.0 mg/l; during data interpretation, place greater emphasis on sample volumes with higher total depletion; the best sample volumes for BOD calculations are those between 25% and 75% of the initial dissolved oxygen (DO) values; place more emphasis on sample volumes with greater than 2.0 mg/l net depletion; do not use sample volumes with final DO < 1.0 mg/l; plot BOD versus sample volumes to determine inhibition; and use sample volumes below the threshold inhibition values for BOD calculations. (Rochester-PTT)

OVERVIEW OF GRANTS FOR SEWERAGE

FACILITIES, M. Gaydos-Chambers. Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 6, p 21-23, November 1986.

Descriptors: *Wastewater treatment facilities, *Pennsylvania, *Grants, *Financing.

Opportunities for sewerage funding in Pennsylvanian light of changes in federally funded programs, reductions in overall grant availability, and increased competition for limited monetary resources are discussed. The Environmental Protection Agency Construction Grants Program remains the primary funding source for sewerage treatment facilities, but at 55% funding level of eligible costs, alternative grant sources must be researched. Other programs include the Housing and Redevelopment Assistance Program (Small Communities Program), the Pennsylvania Department of Community Affairs, the Community Development Block Grant Program (Small Communities Program), the Pennsylvania Department of Commerce's Community Facilities Program, State of Pennsylvania programs aimed at saving jobs, such as the Mid Mon Valley Economic Revitalization Program, and the Farmer's Home Administration grant/loan programs. (Rochester-PTT) PTT) W87-04809

RECENT SEWAGE FINANCING IN PENNSYL-

VANIA,
Collings, Legg, Mason, Inc., Philadelphia, PA.
H. Chapman.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 6, p 25, NovemberDecember 1986.

Descriptors: *Wastewater treatment facilities, *Financing, *Pennsylvania, *Bond issues, Interest

Recent financing arrangements by the following Pennsylvania authorities for sewage projects are summarized: Fairview Township, West Goshen, Catassauqua Borough, East Whiteland Township, Borough of Catawissa, Hilltown Township, Hampton Township and Township of Allegheny County, and Oil City General Authority and City in Venango County. Municipal bond interest rates have remained at low levels despite a flood of bond issues coming to market to beat the September 1st tax deadline. Insuring a bond, as was done by Hampton Township, helps to secure a Triple A rating for the bond, but costs 0.008% of the total interest and principal over the life of the bond issue, charged at issuance. This translates into roughly 0.375% of the interest rate on the bonds. Unless 0.005% is saved on the bond interest by this procedure, only commissions are being generated. ions are being generated procedure, only com (Rochester-PTT)

W87-04810

REMOVAL OF INTESTINAL NEMATODE EGGS IN TROPICAL WASTE STABILIZATION

PONDS, Universidade Federal da Paraiba, Joao Pesso Estacao Experimental de Tratamento

Universidade Federal da Paratoa, Joao Pessoa (Brazil). Estacao Esperimental de Tratamentos Biologicos de Esgotos Santarios.
D. D. Mara, and S. A. Silva.
Journal of Tropical Medicine and Hygiene, Vol. 89, No. 2, p 71-74, April 1986. 3 tab, 6 ref.

Descriptors: "Effluents, "Wastewater treatment, "Nematodes, "Stabilization ponds, "Tropical regions, "Brazil, Ascaris, Hookworms, Anaerobic lagoons, Retention time, Secondary wastewater

Removal of intestinal nematode eggs from domestic wastewater in waste stabilization ponds was studied in northeast Brazil. Anaerobic and primary facultative ponds achieved Ascaris removals of 88 to 98% and 99 to 100%, and hookworm removals of 91-97% and 98-100%, respectively. Egg-free effluents were produced by a single primary facultative pond with a retention time of 18.9 days, and by an anaerobic and secondary facultative pond with retention times of 6.8 and 5.5 days. Effluents less than or equal to one egg per liter can be produced by a one day anaerobic pond followed by a five day secondary facultative and a five day maturation pond. (Author's abstract) W87-04835

PROCESSES CONTROLLING MOVEMENT, STORAGE, AND EXPORT OF PHOSPHORUS IN A FEN PEATLAND, Duke Univ., Durham, NC. School of Forestry and Environmental Studies.

For primary bibliographic entry see Field 5E. W87-04842

PROTEIN DEGRADATION IN ANAEROBIC DIGESTION: INFLUENCE OF VOLATILE FATTY ACIDS AND CARBOHYDRATES ON HYDROLYSIS AND ACIDOGENIC FERMEN-TATION OF GELATIN, Amsterdam Univ. (Netherlands). Lab. for Analytical Chemistry.

A. M. Breure, K. A. Mooijman, and J. G. van Andel. Applied Microbiology and Biotechnology, Vol. 24, No. 5, p 426-431, August 1986. 1 fig, 3 tab, 28 ref.

Descriptors: "Wastewater treatment, "Biological wastewater treatment, "Anaerobic digestion, "Proteins, "Blodegradation, "Fatty acids, "Volatile acids, "Hydrolysis, "Fermentation, "Gelatin, "Carbohydrates, Glucose, Lactose, Cultures, Performance evaluation.

ance evaluation.

The hydrolysis and fermentation of gelatin in the presence of a carbohydrate by gelatin-adapted mixed anaerobic bacterial populations in putatively carbon-limited chemostat cultures was investigated. In one series of experiments, gelatin was fed to mixed populations of bacteria in chemostat cultures operated at different dilution rates. After reaching steady state conditions, a relatively high concentration of glucose or lactose was added to the gelatin-containing growth medium as a second substrate. In a second seres of experiments, a mixture of volatile fatty acids was added to the growth medium along with gelatin to investigate whether the retardation of degradation of gelatin in the presence of high amounts of glucose was due to the glucose itself or was caused by its fermentation products. Degradation of the protein was progressively retarded with increasing dilution rates, as well as with increased concentrations of carbohydrates present in the feed as a second substrate. It was established that this is not due to high concentrations of fermentation products in the reactor. The carbohydrate was totally fermented at all dilution rates. It is concluded that for optimal performance of an anaerobic digestion system for purifying waste waters containing carbohydrates protein mixtures, fermentation of carbohydrates should be spatially separated from hydrolysis and fermentation of the protein. (Author's abstract)

W87-04849

COMPARISON OF DIFFERENT CELLULOLY-TIC FUNGI FOR BIOCONVERSION OF APPIE DISTILLERY WASTE, Institut za Nuklearne Nauke Boris Kidric, Bel-grade (Yugoslavia). J. Friedrich, A. Cimerman, and A. Perdih. Applied Microbiology and Biotechnology, Vol. 24, No. 5, p 432-434, August 1986. 4 fig, 1 tab, 7 ref.

Descriptors: *Biological waster Pescriptors: "Diological wastewater treatment, "Wastewater treatment, "Fungi, "Apples, "Distillery wastes, "Spoil disposal, "Biodegradation, Filtration, Feeds, Fermentation, Proteins, Chemical oxygen demand, Comparison studies.

The suitability of three ascomycetous fungi, Aspergillus niger, A. awamori and Trichoderma reesei, as well as two basidiomycetes, Pleurotus ostreatus and Phanerochaete chrysosporium, for bioconversion of apple distillery slop was compared. Trichoderma and Phanerochaete degraded raw fibers by 20%, producing filter cakes with 17% and 22% raw protein contents. Aspergillus spp. were superior in filtration time and chemical oxygen demand reduction and were of the same efficiency in protein synthesis as Trichoderma and Phanerochaete, but did not degrade fibers. Pleurotus ostreatus did not degrade lignin under the fermentation conditions used and could not compete with other fungi due to its slower growth. (Author's abstract) W87-04850

OBSERVATIONS ON A MICROBIAL CELLU-LOSE DEGRADATION PROCESS THAT DE-CREASES WATER ACIDITY, Canada Centre for Mineral and Energy Technolo-gy, Ottawa (Ontario). A. Jongejan. International Biodeterioration, Vol. 22, No. 3, p 207-211, September 1986. 2 fig, 1 tab, 23 ref.

Descriptors: *Wastewater treatment, *Water treatment, *Acid mine waters, *Microbial degradation, *Acidic water, *Cellulose, Chloride, Oxygen, Bacteria, Oxidation, Mine drainage, Hydrogen in concentration, Oxidation, Permanganate, Metabotics of the characteristics of the char

lism, Bisulfites.

A microbial cellulose degradation process that produces the organic nutrients required by sulfate reducing bacteria and abates acid mine water pollution is reviewed. Observations were made in a series of experiments that investigated the decrease in water acidity by bacteria using cellulose, cellulose chloride relationships, cellulose oxygen linkage and the bacterial species acting on cellulose. No conclusions about relevant metabolic processes are made because of the complexities in cellulose chemistry and microbiology, but the following observations may be noteworthy for further investigations: the action of pH increasing bacteria covers two distinct processes as suggested by the relationships between pH and the bisulfite addition, permanganate oxidation and chloride uptake of cellulose exposed to bacteria; the extent of permangante oxidation of cellulose subjected to pH increasing bacteria is lower than that exposed to cellulolytic bacteria; the variety of species that decreased acid-tive suggests that this process is not based on extremely rare metabolic properties; and, chemical oxidation of cellulose by periodate is different from microbial action. (Michael-PTT)

UTILIZATION BY FATTENING CATTLE OF UNFERMENTED MANURE AND TWO RESI-DUES PRODUCED BY ANAEROBIC GENERA-TION OF METHANE FROM FEEDLOT TION OF

California Univ., Davis. For primary bibliographic entry see Field 5E. W87-04862

CHARACTERIZATION OF MAJOR AND MINOR ORGANIC POLLUTANTS IN MINOR ORGANIC POLLUTANTS IN WASTEWATERS FROM COAL GASIFICATION

Georgia Inst. of Tech., Atlanta. Dept. of Environ-mental Engineering.

For primary bibliographic entry see Field 5A.

WATER SYSTEMS STANDARDS SURVEY, Austin Water and Wastewater Utility, TX. For primary bibliographic entry see Field 5F. W87-04903

SURFACE CHEMISTRY IN WATER TREAT-MENT: REACTIONS AT THE SOLID-LIQUID INTERFACE,

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources. For primary bibliographic entry see Field 5F. W87-04909

UTILIZATION OF ANAEROBICALLY DI-GESTED POULTRY MANURE EFFLUENT NI-TROGEN AS FERTILIZER, Wageningen Water Pollution Control Dept., Wa-geningen (Netherlands). For primary bibliographic entry see Field 5E. W87-04935

THERMOPHILIC ANAEROBIC DIGESTION OF SCREENED-FLUSHED SWINE WASTE. Auburn Univ., AL. Dept. of Agricultural Engi-

D. T. Hill, J. P. Bolte, and T. J. Prince. Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 229-234, January-February 1986. 1 fig. 4 tab, 22 ref.

Descriptors: *Thermophilic anaerobic digestion, *Anaerobic digestion, *Swine wastes, *Animal wastes, *Waste treatment, Fermentation, Methane, Costs, Energy, Temperature, Organic loading, Performance evaluation, Volatile solids, Retention

Flushing waste transport systems are used in approximately 70 to 80% of the swine production facilities in Alabama and the Southeastern United States. Using these flushed wastes to produce methane requires reconcentrating the waste stream since total solids are much less than that required in operating anaerobic digestion systems. The cost of the actual reactor vessel is a major factor in anaerobic fermentation for onsite energy production. Thermophilic digestion offers the smallest plant volume for a given waste mass due to the heavier organic loading concentration and the reduced detention time that can be used when operating at the elevated temperature (55 C). Little research work has been reported using thermophilic digestion of swine waste and no work has been performed using a screened-flushed swine waste as a thermophilic digestion substrate. This experiment involved 4 hydraulic retention times (HRT) (15, 10, 7 and 5 days) utilizing loading concentrations varying from 55 to 64 g VS/L at thermophilic temperature (55 C) using 380 L bench scale digesters. All HRT's were replicated in the study. The operating and performance characteristics of the digesters are reported for each HRT. Heavy loading (i.e. 64 g VS/L) and short HRT's (5 days) showed no signs of digester stress or failure with the volumetric methane productivity in the 4.7 to 4.8 L CH4/L-day range. Volatile solids reductions varied from a high of approximately 64% to a low of 53% as HRT decreased from 15 to 5 days. (Author's abstract) (Author's abstract) W87-04936

FLOW, THE KEY MEASUREMENT, For primary bibliographic entry see Field 7B. W87-04977

STATIC MIXERS BRING BENEFITS TO WATER/WASTEWATER OPERATIONS, Koch Engineering Co., Inc., Wichita, KS. Static Mixing Group.
For primary bibliographic entry see Field 8C.
W87-04983

Group 5D—Waste Treatment Processes

DESIGNING WASTEWATER PLANTS FOR DESIGNING WASLEWALES REAL PEOPLE, CH2M/Hill, Denver, CO. R. E. Pailthorp, and G. J. Swanson. Water Engineering and Management WENMD2, Vol. 133, No. 11, p 35-37, November 1986. 4 fig, 1

Descriptors: *Wastewater treatment facilities, *Wastewater treatment, *Design criteria, *Safety, Hazards, Accidents, Human engineering, Planning, Project planning.

Wastewater treatment plant operations are hazardous and have one of the highest lost-time accident rates in the nation with common mishaps taking a greater toll than the industry-specific accidents. Designs which contribute to the high accident rates come from both design flaws and from unexpected changes in field conditions. Several examples in which required changes to the plans or poor integration of separate design elements caused dangerous situations to arise were presented. Ways in which the work environment can contribute to accidents were discussed and design improvement suggestions were made. (Wood-PTT)

MODELING SEDIMENT-INDUCED DENSITY CURRENTS IN SEDIMENTATION BASINS. CURRENTS IN SEDIMENTATION BASINS, Southern Illinois Univ. at Carbondale. Dept. of Engineering Mechanics and Materials. B. A. DeVantier, and B. E. Larock. Journal of Hydraulic Engineering (ASCE) JHENDS, Vol. 113, No. 1, p 80-94, January 1987. 11 fig, 1 tab, 21 ref. NSF Grant CME-7914762.

Descriptors: *Mathematical models, *Wastewater treatment, *Model studies, *Density currents, *Sediments, *Sedimentation basins, Flow patterns, Prediction, Currents, Flow, Solids, Clarifiers, Set-

Sedimentation basins are used in water and wastewater treatment plants and in a variety of wastewater treatment plants and in a variety or industrial processes to separate suspended solids from water. Most designs utilize continuous flow; consequently, the design engineer must ensure that flow velocities in the basins are sufficiently low to consequently, the design engineer must ensure that flow velocities in the basins are sufficiently low to allow solid particles to settle and be removed, and yet sufficiently high so that the basin volumes are not prohibitively large. Settling basins are often designed by using simple rules of thumb based on detention times, overflow rates, and weir overflow rates. Sediment-driven density currents exist in most secondary sedimentation basins and cause the usual hydrodynamic flow pattern in these basins to deviate substantially from uniformity. The mathematical model introduced here allows one to predict, by direct computation, the behavior of the bottom current and the surface return flow for flow conditions that are representative of a typical secondary clarifier in a sewage treatment plant, and simultaneously to determine their distributional effects on the sedimentation process itself. The model consists of conservation equations for fluid mass and momentum and sediment volume, supplemented by a modified form of the kappa-epsilon turbulence closure model. These results include the flow pattern, concentration distribution of sediment, the percentage of solids removal, and some examination of turbulence quantities in the basin. The strength of the bottom current is closely related to the solids removal rates are, in turn, strongly related to the suspension-settling characteristics. (Alexander-PTT)

URINARY MUTAGENS IN MUNICIPAL SEWAGE WORKERS AND WATER TREAT-MENT WORKERS, New York State Coll. of Veterinary Medicine, Ithaca.

For primary bibliographic entry see Field 5C. W87-05027

EVALUATION OF MANAGEMENT PRACTICES FOR MINE SOLID WASTE STORAGE, DISPOSAL, AND TREATMENT, PEDCo-Environmental, Inc., Cincinnati, OH. ental, Inc., Cincinnati, OH.

For primary bibliographic entry see Field 5E. W87-05083

DESIGN, INSTALLATION AND OPERATION OF WITHDRAWAL WELL CONTAMINANT RECOVERY SYSTEMS, Davis (Ken E.) Associates, Baton Rouge, LA. For primary bibliographic entry see Field 5G. W87-05154

FEASIBILITY OF TREATING CONTAMINATED GROUND WATER AT A HAZARDOUS WASTE SITE,

GCA Corp., Bedford, MA. GCA Technology

Div. N. M. Ram, P. Exner, R. Bell, and S. Santos. IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 513-535, 6 fig. 3 tab, 11 ref. EPA Contract No. 68-01-6769.

Descriptors: *Groundwater pollution, *Hazardous wastes, *Waste disposal, *Water pollution treatment, *Coventry, *Rhode Ialand, Path of pollutants, Plumes, Surface water, Hydrogen ion concentration, Air stripping, Filtration, Adsorption, Carbon, Computers, Model studies.

Ground- and surface water collected at the Picillo Farm site in Coventry, Rhode Island is contaminated with a considerable quantity of both volatile and non-volatile compounds originating from the prior disposal of hazardous wastes at the site. An Endangerment Assessment and Feasibility Study was conducted to identify the problems and evaluate remedial measures for site cleanup. The contaminated ground and surface waters migrate in two plumes toward downgradient surface water discharge areas where they are largely adsorbed onto swamp berosits, biodegraded, or are volatilized from swamp surface waters. A groundwater recover and treatment system was designed to remove essentially all organics, with the exception of methyl ethyl ketone, methylene chloride and acetone, to mitigate a major potential source of odor generation and to recovery a potential odor generation and to recovery a potential groundwater resource that could be used in the groundwater resource that could be used in the future if necessary. Due to the uncertainties associ-ated with the characterization of till and bedrock as distinct, water-bearing formations, two ground-water recovery alternatives were examined: a well-point system, and a subsurface drain. The groundpoint system, and a suosurrace urain. The ground-water treatment deemed necessary at the site in-cluded: (1) pH adjustment, (2) air stripping with vapor recovery, (3) sand filtration, (4) secondary pH adjustment and (5) carbon adsorption. pH adper adjustment and (3) caron adsorption, per adjustment and subsequent air-stripping and sand fil-tration would be expected to remove volatile or-ganic compounds, and iron and manganese oxides as well as hydroxides which could clog the carbon as well as hydroxides which could clog the carbon filter. Exhaust gases from the air stripper would be removed by a carbon vapor recovery unit. Based upon computer modeling, it was estimated that an air stripper with an air:water ratio of 100:1 would be needed to remove the volatiles effectively. (See also W87-05128) (Author's abstract) W87-0816.

5E. Ultimate Disposal Of Wastes

FACTORS AFFECTING THE RESPONSE OF CUT GRASS TO THE NITROGEN CONTENT OF DAIRY COW SLURRY, National inst. for Research in Dairying, Reading

Rational Masses (England).
B. F. Pain, K. A. Smith, and C. J. Dyer.
Agricultural Wastes AGWADL, Vol. 17, No. 3, p
189-202, 1986. 5 fig, 5 tab, 14 ref.

Descriptors: *Farm wastes, *Water pollution effects, *Waste disposal, *Nitrogen fertilizers, *Grasses, *England, *Wales, *Land application, *Animal wastes, Rainfall, Plant growth, Ammonium nitrate, Dry matter yield, Seasonal variation.

Applications of dairy cow slurry and mineral fertilizer were made at a range of N rates, in either

spring or summer, to grass plots cut for silage. A total of 27 sites on medium-textured soils were total of 27 sites on medium-textured soils were used over 3 yr covering a range of climatic conditions in England and Wales. The efficiency of utilization of the slurry N was calculated by comparing herbage dry matter (DM) yields from slurry applications with those from fitted curves of response to ammonium nitrate N. Although location, rainfall, slurry DM, and soluble N content appeared to influence the efficiency of slurry N on occasions, rate and time of application were the most important at each site. The efficiency of slurry N averaged over all experiments ranged from 38% for a low rate of application in spring and down to 17% for a high rate in summer; the combined effects of slurry N and fertilizer N were additive. The apparent recovery of slurry N by the combined effects of surry N and fertilized N weight additive. The apparent recovery of slurry N by the crop ranged from 28% to 9%. The residual effects of slurry N on herbage yields later in the same season were consistently low. (Author's abstract)

FIXATION AND SOLIDIFICATION OF WASTES,

J. R. Con Chemical Engineering CHEEA3, Vol. 93, No. 21, p 79-85, November 10, 1986. 4 tab, 8 ref.

Descriptors: *Waste disposal, *Chemical fixation, *Solidification, *Municipal wastes, *Solids handling, *Solids disposal, *Environmental impact, *Wastewater facilities, Cost

Chemical fixation and solidification of wastes are defined and reviewed, under the following headings: nonchemical systems, organic systems, inorganic systems, choosing the right Chemical Fixation-Solidification (CFS) system, properties of the waste (toxicity, medium, physical properties, chemical properties, and working hazards), waste source, CFS processes and equipment, design parameters, solids handling, volume increase, the disposal site, environmental impact, leaching test and leachability, and commercial considerations and costs. (Rochester-PTT) W87-04369

MODELLING FRESH WATER INJECTION INTO A PARTIALLY SALINE PARTIALLY FRESH (PASPAF) AQUIFER, Technion - Israel Inst. of Tech., Haifa. Faculty of

Civil Engineering.
For primary bibliographic entry see Field 2F.
W87-04404

EXTRACTABILITY AND PLANT AVAILABIL-ITY OF MOLYBDENUM FROM INORGANIC AND SEWAGE SLUDGE SOURCES, Ohio State Univ., Columbus. For primary bibliographic entry see Field 5B. W87-04444

EFFECT OF CADMIUM- AND ZINC-TREATED SLUDGE ON YIELD AND CADMIUM-ZINC UPTAKE OF CORN, Cornell Univ. Agricultural Experiment Station, Ithaca, NY. Dept. of Agronomy. For primary bibliographic entry see Field 5C. W87-04446

WASTEWATER RENOVATION IN A SLASH PINE PLANTATION SUBJECTED TO PRE-SCRIBED BURNING,

Georgia Univ., Athens. School of Forest Re-J. T. Red, and W. L. Nutter.

Journal of Environmental Quality JEVQAA, Vol. 15, No. 4, p 351-356, October-December 1986. 8 tab, 24 ref.

Descriptors: *Wastewater renovation, *Pine trees, *Incineration, *Wastewater disposal, *I.and disposal, *Waster pollution effects, *Forest management, *Irrigation, Concentration, Artificial drainage, Soil acidity, Nutrients, Species composition, Population density, Soil horizons.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Ultimate Disposal Of Wastes—Group 5E

Land treatment is a process that utilizes the biotic and abiotic components of a soil/vegetation system to renovate wastewater. Wastewater constituents are treated through vegetative uptake and storage, adsorption and fixation by soil and organic material, and by microbial processes and chemical transformations. The general operational criterion for a land treatment system is that groundwater effluent from a site meet drinking water standards. A wide variety of ecosystems have proven effective in renovating wastewater and meeting the operational criterion. Two experimental areas were established in an underdrained 16-yr-old slash pine (Pinus elliotiti Mor.) plantation land treatment system receiving 2.5 cm/week of secondarily treated domestic wastewater. One of the experimental areas was subjected to a prescribed burn as a forest system receiving 2.5 cm/week of secondarily freated domestic wastewater. One of the experimental
areas was subjected to a prescribed burn as a forest
management practice. A high degree of
wastewater renovation was achieved and the prescribed burn had no significant effect on
wastewater renovation. Forest floor storage of K,
Ca, Mg, and P increased significantly in the surface
soil horizon due to wastewater irrigation. Additional increases in the surface soil horizon of total
P, Ca, Mg, and K concentration occurred due to
burning. Wastewater irrigation resulted in significant reductions in soil acidity and total-Kjeldahl N
concentration in the surface horizon. Prescribed
durning altered species composition and density of
the understory. No significant differences in overstory nutrient storage were observed due to treatment. (Alexander-PTT)
W87-04447

CHARACTERIZATION OF CADMIUM AND ZINC IN FOUR SOILS TREATED WITH SEWAGE SLUDGE,

Auburn Univ., AL. Dept. of Agronomy and Soils. For primary bibliographic entry see Field 5C. W87-04448

MOLYBDENUM ACCUMULATION BY CORN AND SOYBEANS FROM A MOLYBDENUM-RICH SEWAGE SLUDGE, Ohio State Univ., Columbus. For primary bibliographic entry see Field 5B. W87-04449

PLANT AVAILABILITY OF PHOSPHORUS IN SEWAGE SLUDGE COMPOST, Maryland Univ., College Park. For primary bibliographic entry see Field 5B. W87-04451

QUIESCENT CONSOLIDATION OF PHOS-PHATIC WASTE CLAYS,
Florida Univ., Gainesville. Dept. of Civil Engi-

neering.

M. McVay, F. Townsend, and D. Bloomquist.

Journal of Geotechnical Engineering (ASCE)

JGENDZ, Vol. 112, No. 11, p 1033-1049, November 1986. 12 fig, 40 ref.

Descriptors: *Waste disposal, *Clays, *Phosphates, *Mathematical studies, *Model studies, *Pore water, *Waste disposal, *Mathematical models, Ponds, Pore pressure, Water pressure, Void ratio, Stress, Permeability, Permeability coefficient, Fertilizers, Settling basins, Basins, Prediction.

A number of currently employed mathematical formulations used in modeling one-dimensional quiescent consolidation of phosphatic waste clay ponds are reviewed. The four significant equations required to develop both large and small one-dimensional consolidation theory are continuity of solids, fluids, balance of momentum, and a constitutive equation. It is shown theoretically, as well as through an example, that the excess pore water pressure, void ratio, and ground settlements of the models investigated are identical, with the only difference being in the selection of coordinate representation or dependent variables. Correlation between centrifuge prediction of a prototype pond and theory is presented with material parameters obtained from the laboratory. The most appropriate form of the nonlinear formulation was the complete one, instead of nonlinearized attempts. It was found that small (infinitesimal) theory signifi-

cantly overpredicts settling rates due to the assumed rigidity of the soil skeleton. It is concluded that even though the effective stress versus void ratio representation is acceptable, the present laboratory techniques of finding void ratio versus permeability are deficient. (Author's abstract) W87-04468

TRACERS OF SEWAGE SLUDGE IN THE MARINE ENVIRONMENT: A REVIEW, Lancaster Univ., Bailrigg (England). Lancashire and Western Sea Fisheries Joint Committee. For primary bibliographic entry see Field 5B. W87-04565

REVIEW AND EVALUATION OF CURRENT DESIGN AND MANAGEMENT PRACTICES FOR LAND TREATMENT UNITS RECEIVING PETROLEUM WASTES, Utah Water Research Lab, Logan. For primary bibliographic entry see Field 5D.

For prima: W87-04581

COMPARISON OF THREE RISK ASSESSMENT TECHNIQUES FOR EVALUATING A HAZARDOUS WASTE LANDFILL, Washington State Univ., Pullman. W. W. Budd. Hazardous Waste and Hazardous Materials, Vol. 3. No. 3, p 309-320, 1986. 1 fig. 3 tab, 28 ref.

Descriptors: *Risk assessment, *Waste disposal, *Wastes, *Landfills, *Comparison studies, Hazard Ranking System, Chemical wastes, Environmental policy, Washington.

Three risk assessment procedures were used to evaluate an inactive waste facility in eastern Washington: benchmark comparison, formal subjective analysis, and the Hazard Ranking System (HRS). Using benchmark comparison and formal subjective evaluation the site was found to pose limited hazard to humans and the environment. The HRS appearable was shough to produce a wide range of approach was shown to produce a wide range of values. In all but 10% of the cases, the HRS technique produced scores which would not place the site on the National Priorities List. The effections are the site on the National Priorities List. The effections are the site on the National Priorities List. tiveness of the formal subjective approach was seen as significant, and could be potentially useful given projected demands for future waste sight evaluations. (Author's abstract) W87-04688

LINEAR ALKYLBENZENE SULFONATES (LAS) IN SEWAGE SLUDGES, SOILS AND SEDIMENTS: ANALYTICAL DETERMINATION AND ENVIRONMENTAL SAFETY CON-

SIDERATIONS,
Procter and Gamble European Technical Center,
Brussels (Belgium).
For primary bibliographic entry see Field 5A.
W87-04623

AGRONOMIC VALUE OF THE SEWAGE SLUDGE OF TENERIFE. COMPOSTING, Centro de Edafologia y Biologia Aplicada de Ten-

centro de Edamologia y Biologia Apricada de l'en-erife (Spain). E. I. Jimenez, V. P. Garcis, and M. F. Falcon. Agricultural Wastes AGWADL, Vol. 17, No. 2, p 119-130, 1986. 1 fig. 3 tab, 26 ref.

Descriptors: *Agronomic value, *Sludge, *Sludge disposal, *Land disposal, *Recycling, *Composting, Organic matter, Nutrients, Fertilizers, Minerals, Heavy metals, Tenerife, Physicochemical properties, Agriculture.

At present, the three most important systems of utilizing sewage sludge from the sewage stations are direct use in agriculture after sterilization, incineration with recovery of energy and composting. There are other systems in the investigative stage such as gasification, pyrolysis, production of combustible briquettes, production of proteins for animal feed, etc. One of the most effective ways of recycling the organic and mineral fractions of sludge from the treatment of domestic wastewater is to compost the sludge with the organic fraction

of domestic refuse. In the present study, a compost on a semi-industrial scale was obtained from a mixture of domestic refuse and sewage sludge. The evolution of the different parameters throughout the process was noted and the most interesting physico-chemical characteristics from an agricultural point of view determined. The compost, because of its high percentage of total organic matter (43.62%), its relatively high N, P, K, Ca and Mg contents (2.82%, 1.25%, 1.63%, 5.16% and 1.07%, respectively), its balanced oligoelement levels and low content of non-essential heavy metals, can be considered, in principle, a good organic fertilizer with possibilities for use in the agriculture of the island of Tenerife. (See also W87-04628) (Alexander-PTI) der-PTT) W87-04626

AGRONOMIC VALUE OF THE SEWAGE SLUDGE OF TENERIFE. PHYSICO-CHEMI-CAL CHARACTERISTICS OF THE REFUSE-SLUDGE COMPOST AND RELATED PROD-

Centro de Edafologia y Biologia Aplicada de Ten-

cerife (Spain).
V. P. Garcia, E. I. Jimenez, and M. F. Falcon.
Agricultural Wastes AGWADL, Vol. 17, No. 2, p
141-152, 1986. 4 tab, 30 ref.

Descriptors: *Agronomic value, *Sludge, *Sludge disposal, *Sludge compost, *Recycling, *Waste disposal, *Land disposal, *Water pollution effects, Municipal wastewater, Tenerife, Wastewater treatment, Comparison studies, Nutrients, Fertilizers, Agriculture, Organic matter, Heavy metal

The application of organic matter to agricultural land in the island of Tenerife has decreased considerably in recent years as a result of the almost total disappearance of traditional sources of organic dressings-animal manure and forest residue. The dressings-animal manure and forest residue. The most important agronomic characteristics of the sewage sludge from the Tenerife wastewater treatment plant and the compost obtained by composting of this sludge with the organic fraction of municipal refuse was evaluated. A comparative study is also carried out on several commercial products used as overanic dressings on the island. products used as organic dressings on the island's agricultural soils. From the results obtained, the direct use (after sterilization) of agricultural soils. From the results obtained, the direct use (after sterilization) of sewage sludge could be very interesting from the agricultural point of view. The compost obtained, because of its high total (43.6%) and oxidizable (37.3%) organic matter content, its high fertilizer elements concentration (N, 2.8%; P, 1.3%; K, 1.6%; Ca, 5.2% and Mg, 1.1%), its balanced essential elements content and moderate toxic heavy metals levels, can be considered a good organic fertilizer whose use could represent a great saving in chemical fertilizers and replace the manuters formerly used, which are now almost non-existent. In addition, it could compete advantageously with the products at present on sale in the island because of its lower cost and better agronomic quality. (See also W87-04626) (Alexander-PTT)

IMPLEMENTING DIRECT FILTRATION AND NATURAL FREEZING OF ALUM SLUDGE, Onondaga County Metropolitan Water Board, Syracuse, NY. For primary bibliographic entry see Field 5F. W87-04641

NEGOTIATION AND MEDIATION: NEWEST APPROACH TO HAZAF WASTE FACILITY SITING, TO HAZARDOUS For primary bibliographic entry see Field 5G. W87-04658

LAND APPLICATION ON THE RISE, N. Goldstein. Biocycle BCYCDK, Vol. 27, No. 9, p 22-27, October 1986.

Descriptors: "Waste disposal, "Land disposal, "Sludge disposal, "Cost analysis, Agriculture, Public relations, United States, Future planning, Incineration, Landfills, Ocean dumping.

Group 5E-Ultimate Disposal Of Wastes

Land application of wastewater sludge is reviewed, including reasons for using this method of disposal, regulatory climates, agricultural uses of the sludge, farmer and public responses, the question of fees for sludge, costs of programs, and future prospects. A state-by-state summary of activities in the land application field is included. The latest federal statistics on land application units report 11,937 for municipal sewage sludge and 5,605 for industrial waste. A number of factors are behind the increase in sludge use: (1) a decline in landfilling of sludge, (2) improved economics of land disposal, (3) positive response from farmers involved with sludge applications, (4) increasing numbers of reliable contractors, and (5) stringent, but 'workable' state and federal regulations that make land application feasible for municipalities and contractors yet provide adequate protection for human health and the environment. The future of sludge disposal looks bright. The industry as a whole has a good reputation. Difficulties with incineration, landfilling, and ocean dumping, combined with the changing attitude toward beneficial reuse of sludge will accelerate the trend toward land application and other utilization technologies. (Rochester-PTT)

NEW REGS FOR SLUDGE MANAGEMENT, N. Goldstein. iocycle BCYCDK, Vol. 27, No. 9, p 28-29, Octo-

Descriptors: *Sludge disposal, *Standards, *Regulations, Office of Municipal Pollution Control, Office of Water Regulations and Standards, Virginia Wastewards (*Parthursts of Parthursts of Parthursts (*Parthursts of Parthursts (*Parthursts of Parthursts (*Parthursts of Parthursts (*Parthursts of Parthursts of Parthursts (*Parthursts of Parthur inia. Wastewater tre

The progress in development of regulations covering sewage aludge management is reviewed. Topics include: work of Environmental Protection Agency's Office of Municipal Pollution Control on drafting the State Sewage Sludge Management Program Regulations (40 CFR Part 501), which will require states to develop programs that comply with federal criteria; work of the EPA's Office of Water Regulations and Standards on the technical regulations for sewage sludge use and disposal (40 CFR Part 503); and the example of the state of Virginia's rewriting of its regulations to comply with the anticipated new EPA standards. (Rochester-PTT)

SLUDGE PROCESSING EFFECT ON COM-POST QUALITY, Florida Univ., Gainesville. Inst. of Food and Agri-cultural Sciences. or primary bibliographic entry see Field 5D.

SLUDGE MANAGEMENT: A RESEARCH UPDATE: PART II, Weston (Roy F.), Inc., West Chester, PA. Y, Hasit.

BioCycle BCYCDK, Vol 27, No. 9, p 42-46, Octo-ber 1986, 60 ref.

Descriptors: "Reviews, "Sludge management, "Waste disposal, "Sludge disposal, "Sludge drying, "Sludge thickening, "Disinfection, "Composting, Thermal processes, Vermistabilization, Aeration, Metals, Crop yield, Cost analysis, Marketing, Land disposal, Wastewater treatment, Strip mines, Land

This final segment of literature a review on aludge covers the 1985 (and some 1984) literature on inactivation, stabilization, thermal processes, and ultimate disposal. Topics include: parameters for assessing sludge stability, vermistabilization, compost aeration, United States composting facilities survey, disinfection and reinfection, co-combustion of sludge with solid wastes, sludge drying and marketistic land amplication of sludge drying and survey, disinfection and reinfection, co-combustion of sludge with solid wastes, sludge drying and marketing, land application of sludges, effects of aludge metals on crop yield, use of sludge to reclaim strip mines, a mathematical model describing the transport of sludge landfill leachates, and production of lightweight concrete aggregate from mixtures of clay and municipal sludges. (Rochester, PETP)

INDUSTRIAL WASTE REDUCTION: THE PROCESS PROBLEM, New York State Energy Research and Develop-ment Authority, New York. F. W. Valentino, and G. E. Walmet. F. W. Valentino, and G. E. Walmet. Environment ENTVAR, Vol. 28, No. 7, p 16-20, 30-33. September 1986. 2 ref.

Descriptors: *Industrial wastes, *Waste disposal, *State jurisdiction, *New York, *Research priorities, *Regulations, *Wastewater treatment, *Industrial wastewater, Incineration, Tannery wastes, Aerobic disgestion, Fluidized bed process, Cements, Printing plant wastes, Economic efficiency, *Page 2019.

Strategies to deal with front-end disposal of industrial wastes are discussed. The five most common strategies ranging from the least to most costly include reduction of the amount of industrial wastes, reuse of process chemicals with little or no restment securities. wastes, reuse of process chemicals with little or no treatment, recycling process chemicals through treatment, research, development and demonstration of new waste reduction technologies and replacement of the entire industrial process. The potentially negative economic effects of government regulation of industrial waste disposal are discussed in terms of their impact on smaller businesses. The potential benefits of government-indusnesses. The potential benefits of government-indusnesses in the potential benefits of government-indusnesses. The potential benefits of government-indusnesses in the potential benefits of government-indusnesses. The potential benefits of government-indusnesse a fluidized bed bioreactor for treatment of tannery wastes, fume incineration of printing plant wastes and destruction of hazardous liquid organic chemicals in a cement kiln. As illustrated in New York and other states, cooperative nonregulatory programs can reduce industrial wastes while also resulting in substanial energy and economic benefits for the surrounding municipalities. (Michael-PTT) W87-04827.

RESIDENTIAL HEALTH STUDY OF FAMI-LIES LIVING NEAR THE DRAKE CHEMICAL SUPERFUND SITE IN LOCK HAVEN, PENN-SYLVANIA, Pennsylvania Dept. of Health, Harrisburg. Div. of Environmental Health.

For primary bibliographic entry see Field 5C. W87-04827

PILOT STUDY OF SERUM POLYCHLORI-NATED BIPHENTI. LEVELS IN PERSONS AT HIGH RISK OF EXPOSURE IN RESIDENTIAL AND OCCUPATIONAL ENVIRONMENTS, Centers for Disease Control, Atlanta, GA. Center for Environmental Health.
For primary bibliographic entry see Field 5C. W87-04528

PROCESSES CONTROLLING MOVEMENT, STORAGE, AND EXPORT OF PHOSPHORUS IN A FEN PEATLAND, Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
C. J. Richardson, and P. E. Marshall. Ecological Monographs, Vol. 56, No. 4, p 279-302, December 1986. 15 fig. 5 tab, 93 ref. NSF Grants GI-34812x and AEN75-08855.

Descriptors: "Wastewater treatment, "Wastewater disposal, "Phosphorus, "Peat bogs, "Fate of pollutants, "Phosphorus removal, "Nutrients, "Accumpation, Michigan, Peat, Fertilization, Nitrates, Plant growth, Plant tissues, Microbial degradation, Microenvironment, Adsorption, Peat soils, Phosphates, Standing waters, Field tests.

Field and laboratory studies were conducted to determine the mechanisms controlling P move-ment, storage and export from a minerotrophic peatland in central Michigan that had demonstrated high P removal from nutrient additions. An annual P budget determined plant uptake require-

ments, but 35% of aboveground uptake was returned to the peatland via litterfall. Both microbial uptake and soil exchange capacity controlled the amount of P made available for plant growth. Fertilizer additions resulted in no significant in growth or nutrient uptake by emergent macrophytes because the litter-microorganism compartment (LMC) retained up to 84% of the added P in the first year. Doubling P fertilization resulted in an LMC retention of only 57%. Higher level N and P fertilizer additions applied with minimal water increased net primary productivity and P storage by narrow-leaved sedge. Microcosm 32P studies indicated that most P added to the fen was removed from the water column within the first hour by microorganisms and fine sediments, and that sedge uptake was extremely low even 45 days after addition. Plant uptake of P is not a major factor in rapid removal of low levels of newly added PO4. Freezing resulted in P release to the water column upon thawing, but concentrations returned to control levels within 24 hours. Study results suggest that soil adsorption and peat accumulation control long-term phosphate sequestration, but microorganisms and small sediments control initial uptake rates, especially during period of low nutrient concentration and standing surface water. (Author's abstract)

ASSESSMENT OF A NATURAL WETLAND RE-CEIVING SEWAGE EFFLUENT, Commonwealth Scientific and Industrial Research Organization, Griffith (Australia). Centre for Irri-gation Research. For primary bibliographic entry see Field 5C. W87-04860

UTILIZATION BY FATTENING CATTLE OF UNFERMENTED MANURE AND TWO RESI-DUES PRODUCED BY ANAEROBIC GENERA-TION OF METHANE FROM FEEDLOT MANURE MANURE, California Univ., Davis. T. L. North, and W. N. Garrett. Journal of Animal Science JANSAG, Vol 63, No. 2, p 348-357, August 1986. 8 tab, 20 ref.

Descriptors: *Waste disposal, *Recycling, *Waste recovery, *Wastewater treatment, *Diets, *Nutrients, *Manure, *Anaerobic digestion, *Feedlots, *Feedlot wastes, *Methane, *Feeds, Cattle, Animal metabolism, Pilot plants, Fermentation, Performance evaluation.

Two fermented manure residues (FM) from the pilot plant anaerobic digestion of commercial feed-lot manue for methane generation were compared with unfermented manure (UFM) in beef steer with unfermented manure (UFM) in beef steer metabolism and comparative slaughter feedlot trials utilizing diets formulated to replace 10, 20 and 30% of a control diet with each manure product on an a-fed basis. A 10/21 FM was produced by a 21-day digestion of a 10% organic matter manure slurry and a 5/7 FM was produced by a seven-day digestion of a 5% organic manure alurry. Metabolism-trial-determined dry and organic matter digestibles, digestible energy and total digestible nutrients (TDN) decreased as level of manure product increased, except for UFM diets above 10% in which only TDN decreased with increased manure level. Feedlot trial performance indicated an increase in daily dry matter intake, but a decrease in average daily gain and energy gain as level of manure product increased. Using fasting heat production and energy deposition data for maintenance and ad libitum-fed steers, net energy values for maintenance and again were estimated. UFM had very little energy value for fattening maintenance and ad libitum-fed steers, net energy values for maintenance and gain were estimated. UFM had very little energy value for fattening cattle, and fermenting the manure removed any energy value the manure originally posessed. Consequently, manure scaped from the dirt-floor pens of a commercial feedlot, especially after fermentation in an industrially constructed methane generating pilot plant, was not considered an optimal energy source for cattle fattening diets. (Author's abstract)

ANAEROBIC BACTERIAL DISSOLUTION OF LEAD OXIDE.

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Ultimate Disposal Of Wastes-Group 5E

Brookhaven National Lab., Upton, NY. Dept. of Applied Scie

For primary bibliographic entry see Field 5B. W87-04874

POINT-SOURCE INPUTS OF PETROLEUM WASTEWATER INTO THE NIGER DELTA, NI-

WASIEWATER INTO THE NIGER DELTA, NI-GERIA, Rivers State Univ. of Science and Technology, Port Harcourt (Nigeria). Inst. of Pollution Studies. Por primary bibliographic entry see Field 5B. W87-04881

LOW-LEVEL RADIOACTIVITY IN THE IRISH

SEA,
For primary bibliographic entry see Field 5B. W87_0488

UTILIZATION OF ANAEROBICALLY DI-GESTED POULTRY MANURE EFFLUENT NI-TROGEN AS FERTILIZER, Wageningen Water Pollution Control Dept., Wa-geningen (Netherlands). J. A. Field, R. B. Reneau, W. Kroontje, and J. S.

Caldwell. Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 223-228, January-February 1986. 2 fig, 4 tab, 37 ref.

Descriptors: *Land application, *Anaerobic digestion, *Poultry manure, *Animal wastes, *Manure, *Effluents, *Nitrogen, *Fertilizers, *Waste disposal, Performance evaluation, Nutrients, Grain yield, Corn, Statistical analysis, Silage, Soil types.

al, Performance evaluation, Nutrients, Grain yield, Corn, Statistical analysis, Silage, Soil types.

The effect of the anaerobic digestion process on the N fertilizer value of litter-free poultry manure was evaluated. Both undigested poultry manure influent TKN (46% NH4(+)-N) and digested poultry manure effluent TKN (88% NH4(+)-N) application (146 kg/ha) for corn (Zea mays L.) yield at 2 sites. One site (1) was a Groseclose silt ioam (Clayey, mixed, mesic, Typic Hapludult) and the other (site 2) was a Hayesville loam (clayey, oxidic, mesic, Typic Hapludult). The effluent treatments produced 7.3 and 0.9% lower grain yield compared to the influent treatments at sites 1 and 2, respectively; however, the grain yields (including the grain yields from urea) were not significantly different (P<-0.05). Silage yields from the effluent treatments were statistically lower (16.6%) than silage yields from urea application at site 1 (silage yields were not statistically different between urea and influent nor between influent and effluent treatments). Both silage and grain yields were highly correlated (R squared ranged from 0.69 to 0.99) with applied TKN and soil inorganic N when results were least squares fitted to the Mischerlich equation. The anaerobic digestion process did not significantly change the value of the manure as a N fertilizer. However, a trend of lowered yields corresponded to greater estimated N losses (42 to 55% of applied TKN) from the effluent treatments compared to influent (8 to 23% of applied TKN) and urea (30% of applied TKN) volatitation and occurred during the first week. The increase in manure NH4(+) and pH by digestion probably increased the NH3 volatilization potential of effluents compared to their corresponding influents. To minimize N losses, anaerobically digested manure should be incorporated in the soil rather than broadcast and applied in the soil rath

SALMONELLOSIS IN TWO DAIRY HERDS ASSOCIATED WITH A SEWAGE FARM AND WATER RECLAMATION PLANT,

Ministry of Agriculture, Fisheries and Food, Loughborough (England). Veterinary Investigation Centre. ary bibliographic entry see Field 5C.

W27.04089

WORLD BANK SERIES ON INTEGRATED RE-SOURCE RECOVERY, Commission of the European Communities, Brus-sels (Belgium). Concertation Unit for Biotechnol-

ogy. M. F. Cantley. Environment ENTVAR, Vol. 28, No. 8, p 25-29, October 1986. 3 ref.

Descriptors: "Recycling, "Waste recovery, "Wastes, "Solid wastes, "Liquid wastes, "Reviews, "Integrated Resource Recovery, "Developing countries, World Bank series, Economic aspects, Social aspects, Benefits, Technology.

The World Bank acted as the executing agency for a three-year global research and development project of waste recycling called 'Integrated Resource Recovery' which explored ways for achieving economic and social benefits through sustainable resource recovery activities in developing countries by the recycling and reuse of solid and liquid wastes. Reviews of the first four of the project management reports were presented. All of the reports illustrate the 'systems approach' in which the environment is treated neither as an infinite source of resources nor as an infinite sink for wastes. Two of the reports are essentially global and describe practical experience of waste management and recycling in developing countries. The other two detail American and European technology; they were honest about the obstacles to the transfer and integration of such technologies into developing countries. (Wood-PTT) W87-04997

EFFECTS OF CHEMICALLY CONTAMINATED SEWAGE SLUDGE ON AN APHID POPU-

Cornell Univ., Ithaca, NY. Dept. of Entomology. For primary bibliographic entry see Field 5C. W87-05009

BIOTOXICITY OF TRACE METALS AND COMPOSTED SLUDGE/MINERAL SUB-

COMPOSTED SLUDGE/MINERAL SUB-STRATE INTERACTIONS, Ecole Polytechnique Federale de Lausanne (Switzerland). Dept. de Genie Rural et Geometre. J. C. Vedy, T. Dellis, and A. C. M. Bourg. Toxicological and Environmental Chemistry TXECBP, Vol. 12, No. 3/4, p 237-254, 1986. 2 fig.

Descriptors: *Biotoxicity, *Trace metals, *Sludge digestion, *Composted sludge, *Heavy metals, *Waste disposal, Biomass, Respiration, Incubation, Compost, Sludge, Toxicity, Extraction, Cadmium, Copper, Zinc, Sandstones, Granites.

The application in Switzerland of a federal ordinance on the protection of water ecosystems and the concomitant development of treatment plants are resulting in the production of an increasing amount of sludge for which a commercially viable utilization must be found. Composting, the only procedure which insures the simultaneous stabilization and effective sanitation of sludge, is an attractive way to recycle at least part of these wastes. The impact of heavy metals (Cd, Cu, Zn) on microbiological respiration and ATP biomass of mixtures of compost (alugge + sawdust) and mineral substrates (arenites of sandstone or granite) was studied by aerobic in vitro incubation for 21 days. The compost was enriched with trace metals, The application in Switzerland of a federal ordiwas studied by aerobic in vitro incubation for 21 days. The compost was enriched with trace metals, corresponding to final contents of 15, 1500 and 3500 ppm for Cd, Cu and Zn, respectively, in the mixture. CO2 measurements were used to follow the global biological activity during the incubation period. Biomass was evaluated by ATP measurements before and after the experiment. Organomineral interactions were characterized by a granulometric fractionation and by chemical extractions. The stronger toxicity of heavy metals observed with granite as compared to sandstone is interpreted by more efficient organo-mineral interactions with the latter. (Alexander-PTT) W87-05034 W87-05034

METAL ASSOCIATIONS IN ANOXIC SEDI-MENTS AND CHANGES FOLLOWING UPLAND DISPOSAL,

Technische Univ. Hamburg-Harburg (Germany,

F.R.). W. Calmano, U. Forstner, and M. Kersten. Toxicological and Environmental Chemistry TXECBP, Vol. 12, No. 3/4, p 313-321, 1986. 3 fig.

Descriptors: *Land disposal, *Waste disposal, *Sludge disposal, *Water pollution effects, *Anoxic sediments, *Sediments, *Heavy metals, Dredging, Extraction, Sludge, Speciation, Transformation, Acidification, Solubility.

The ecological effects of heavy metals in cont ane ecological ericcis of neavy metals in contaminated sediments are more determined by the chemical form and reactivity than by the level of accumulation. Dredging of anoxic sediments and disposal on land is attended by changes of redox conditions. Under oxidizing conditions some controlling solid compounds may change gradually thus changing the solubility of certain metals. Chemical extraction experiments for estimating characteristic association forms of heavy metals in anoxic sediments were carried out, both under characteristic association forms of heavy metals in anoxic sediments were carried out, both under presence and absence of air during the analytical procedure. Drying of the sediment decreases the proportion of the sulfidic metal fractions to a stronger degree, and oxidized Cd and Zn are found in the most available, exchangeable fraction. With respect to long-term effects acidification of poorly buffered sludges after disposal on land is probably the most important factor affecting metal associations and mobility. For many metal examples a linear relationship was found between decreasing pH values and increasing dissolved metal concentrations. To quantify these relationships and for better comparison of samples a simple test procedure is proposed which is based on pH differences before and after addition of acid. (Author's abstract) stract) W87-05035

IN-DEPTH SURVEY AND ASSESSMENT OF DEEP INJECTION WELLS USED TO DISPOSE OF HAZARDOUS WASTE - PRELIMINARY REPORT.

REPORT, Environmental Protection Agency, Washington, DC. Office of Drinking Waster.
V. J. Kimm, F. M. Brasier, and M. Salazar.
IN: Innovative Means of Dealing with Potential Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 97-110, 6 fig.

Descriptors: *Injection wells, *Hazardous waste disposal, *Environmental effects, *Waste disposal, Oil wastes, Industrial wastes, Groundwater pollution, Legislation, Regulations.

tion, Legislation, Regulations.

The practice of using injection wells to dispose of waste started in the oil fields in the 30s and is considered an environmentally desirable method for disposing of oil field brines and other waste fluids resulting from oil and gas production. Injection of industrial waste started in the late fifties and so far has proven a reliable method for disposing of certain wastes. Recent studies by the National Research Council, the General Accounting Office and the Office of Technology and Assessment have all cited waste injection as an inherently better technology than other methods of land disposal of wastes. There have been problems associated with injection wells, but none that have resulted in documented cases of drinking water contamination. All of the problems occurred before the UIC regulations were inplace and could have been avoided if the UIC requirements had been met. They can be tied to improper sting, excessive injection pressures, and lack of monitoring for mechanical integrity. Studies to date indicate that while injection wells are not a panacea, when properly sited, operated and monitored, and for the type of wastes that lend themselves to the technology, they can be an environmentally sound method of disposal. However, whether a specific well should be allowed to operate should remain a case-by-case determination since the interaction bewell should be allowed to operate should remain a case-by-case determination since the interaction between the hydrogeologic setting, construction ma-terial and type of waste injected must always be

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considered. In addition, congressional action related to the reauthorization of RCRA may force a reexamination of the issue of hazardous waste injection as part of the potential ban of one or more methods of land disposal for specific wastes. (See also W87-05071) (Lantz-PTT)

EVALUATION OF CONFINING LAYERS FOR CONTAINMENT OF INJECTED

WASTEWATER, Missouri Univ.-Rolla. Dept. of Geological Engi-

neering.
D. L. Warner, T. Syed, and R. M. Tinlin.
IN: Innovative Means of Dealing with Potential
Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water
Quality Symposium, September 26-28, 1984, Las
Vegas, Nevada. National Water Well Association,
500 W. Wilson Bridge Road, Worthington, Ohio,
1984. p 141-168, 4 fig, 3 tab, 16 ref. EPA Project
No. 68-01-6389.

Descriptors: *Confining layers, *Injection wells, *Environmental effects, *Wastewater disposal, *Monitoring, *Groundwater pollution, Site selection, Porosity, Geohydrology, Geologic faults, Wells, Water pollution effects, Stratigraphy, Quantitative analysis, Hydraulic models.

The general technical requirements of a suitable wastewater injection well site include: (1) An injection interval that is sufficiently thick, extensive, porous and permeable to accept wastewater at the accessary rate at safe injection pressures; (2) Overlying and underlying strats (confining beds) sufficiently thick, extensive and impermeable to confine waste to the injection interval; and (3) The absence of faults or extensive joints or unplugged or improperly plugged abandoned wells that would permit escape of injected wastewater from the nijection interval into adjacent aquifers. Since the advent of the use of injection wells for wastewater disposal, one of the more difficult technical issues has been the determination of the adequacy of confinement of injected liquids within the injection reservoir. This may be a particular problem when the confining interval is relatively thin, shallow, of questionable permeability, is affected by local structural or stratigraphic geologic features, or is penetrated by abandoned wells that may be improperly plugged. Assessment of the adequacy of a confining interval usually involves qualitative evaluation of the stratigraphy, structural geology and hydrogeology of the site but some quantitative or semiquantitative methods are also available for testing and modelling the behavior of confining strata, including the vertical extent of hydraulic fracture growth and the rate of flow of injected wastewater through them. (See also W87-05071) (Author's abstract)

TECHNOLOGICAL CONSIDERATIONS IN CLASS I INJECTION WELLS, Golden Strata Services, Inc., Houston, TX. T. A. Joses, and J. S. Haimson.

T. A. Jones, and J. S. Haimson.

In: Innovative Means of Dealing with Potential Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 169-176, 2 fig. 1 tab.

Descriptors: *Injection wella, *Design standards, *Materials testing, *Waste disposal, Monitoring, Grouadwater pollution, Corrosion control, Tubulars, Cements, Water pollution control.

Technological improvements have advanced the 'state of art' construction techniques for Class I waste disposal wells. Items such as well design, installation, completion and monitoring have been standardized under the Federal Underground Injection Control (UIC) program to provide greater protection against groundwater contamination. Major well design considerations for injection wells are: (1) protection of underground sources of crinking water; (2) control of the corrosion of casings and cement; (3) the reduction of surface

injection pressure; and (4) a reliable annulus monitoring system. Specialized materials of construction are beginning to be used extensively in the
waste disposal well industry to improve mechanical integrity, reduce workovers and most importantly, provide the best possible protection of freah
groundwater resources. Recently installed injection wells utilize oversize corrosion resistant tubulars, optimized completions, acid resistant cements
and specialized packer assemblies. Improved well
construction results in reliable testing of mechanical integrity, a way to monitor the disposal well
and provide preventative maintenance before
groundwater pollution occurs. (See also W8705071) (Author's abstract)

REGULATORY STRATEGY GOVERNING THE DISCHARGE OF MINING WASTE TO LAND IN CALIFORNIA.

IN CALIFORNIA, California State Water Resources Control Board, Sacramento. For primary bibliographic entry see Field 5G. W87-05080

BACKFILLING TECHNIQUES AND ALKA-LINE ADDITION TO CONTROL ACID MINE DRAINAGE IN A COAL STRIP MINE,

Antrim Mining, Inc., Blossberg, PA. N. W. Hedrick, E. W. Meiser Jr., and R. M. Hershey.

In: Innovative Means of Dealing with Potential Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 209-223, 3 fig, 3 tab, 8 ref.

Descriptors: *Backfill, *Alkalinity, *Acid mine drainage, *Mine wastes, *Strip mines, *Tioga County, *Pennsylvania, *Waste disposal, *Groundwater pollution, Coal mines, Pyrite, Oxidation, Path of pollutants, Cost analysis.

A mining company in Tioga County, Pennsylvania, was faced with developing techniques to control acid mine drainage (AMD) in a proposed strip mine adjacent to a deep mine complex. As much as 40 ft (12.2 m) of the total overburden contained ahale high in pyrite; this shale is a known AMD-producer. Four separate problem areas were identified. To prevent oxidation of the pyrite, and allow the discharge from the strip mine to meet state regulations, a waste product from lime manufacturing was used in an attempt to maintain alkaline conditions. A sandstone underdrain was constructed to minimize saturated groundwater conditions and to direct groundwater either to monitoring sumps before release into the abandoned deep mines or toward a common discharge point for treatment. The underdrain capacity was designed to exceed the recharge rate by more than an order of magnitude. Runoff will be promoted and recharge thus reduced by grading the backfill into rolling swales with drainageways floored on compacted glacial till. The fourth task was to develop a materials-handling plan which allowed for the segregation of acidic spoil and selective placement of the alkaline material. The plan developed was economically feasible, under the coal company's contract price commitment, and practically in terms of the available mining equipment and stratigraphic sequence of the mine site. Factors which allowed implementation of the experimental plan to control AMD at this mining site are: (1) source of low-cost lime; (2) favorable stripping ratio of 11.5 to 1; (3) long-term coal sales contract allowed uninterrupted mining at a fixed price; (4) abundant glacial till and topsoil to cap the backfill; and (5) management commitment to carry out the complex mining plan successfully. (See also W87-05071) (Lantz-PTT) W87-05082.

EVALUATION OF MANAGEMENT PRACTICES FOR MINE SOLID WASTS STORAGE, DISPOSAL, AND TREATMENT, PEDCo-Environmental, Inc., Cincinnati, OH. W. E. Thompson, R. L. Hoye, and J. S. Greber. IN: Innovative Means of Dealing with Potential

Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 224-234, 2 tab.

Descriptors: *Waste management, *Path of pollutants, *Mine wastes, *Waste storage, *Waste disposal, *Wastewater treatment, Monitoring, Chlorides, Groundwater quality, Water quality, Lead, Zinc, Gold, Silver, Phosphates, Missouri, Copper, Florida, South Dakota, Nevada, Arizona, New Mexico, Idaho, Monitoring, Geohydrology.

Idaho, Monitoring, Geohydrology.

Recent Federal law (RCRA Sections 8002 (f) and (p)) requires the EPA to study the adverse effects of solid wastes from active and abandoned surface and underground mines on the environment. To support EPA's mandate, field investigations were conducted to collect groundwater and surface water quality data associated with waste handling practices at eight mines across the United States. Waste management practices for the following waste types were monitored: (1) clay slimes and sand tailings from phosphate mining in Florida, (2) tailings from Lead/zine mining in Missouri, 3) tailings from Lead/zine mining in Missouri, 3) tailings from gold/silver mining in South Dakota and Nevada, (4) mine water from uranium mining in New Mexico, (5) tailings from copper mining in Arizona, (6) copper dump leach material in New Mexico, and (7) overburden from phosphate mining in Idaho. Seepage of contaminants from waste management practices was identified in groundwater at each of the seven sites where groundwater as asmpled. The principal contaminants identified included sulfate, chloride, and TDS. Heavy metals, radionuclides, or cyanide from waste management practices were detected above background levels in only isolated cases. Generally the levels of contamination resulting from the waste disposal practices did not result in significant degradation of groundwater quality. Surface water monitoring at five sites indicated no the seven sites indicated no discernible impact or only minimal impact from the waste management practices. The study also demonstrated the problems associated with monitoring and evaluating groundwater impacts caused by large waste disposal facilities situated in complex hydrogeological settings. (See also W87-05071) (Lantz-PTT) W87-05083

REGULATORY STRATEGY GOVERNING THE DISCHARGE OF HAZARDOUS AND NONHAZARDOUS WASTE TO LAND IN CALIFORNIA

NIA, California State Water Resources Control Board, Sacramento. For primary bibliographic entry see Field 5G. W87-0590

CONTRARY WASTE SITE CHARACTERISTICS – GOOD IS BAD, BAD IS GOOD, H. E. LeGrand.

H. E. LeGrand. In: Innovative Means of Dealing with Potential Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 358-366, 2 fig. 4 tab.

Descriptors: *Waste disposal sites, *Geohydrology, *Hazardous wastes, *Path of pollutants, Permeability, Containment systems, Sorption, Water table, Topography, Stream density.

The evaluation of hazardous waste sites has been hampered because the hydrogeologic factors involved are complexly interrelated and often contrary. These factors are so intertwined that no site can have favorable features only, without any unfavorable ones. For example, low permeability for the purpose of waste containment is normally favorable but is likely to be associated with a high water table, which is unfavorable. Seven key hydrogeologic factors — Permeability, Sorption, Water Table Depth, Water Table Gradient, Stream Density, Topography, and Ground Distance — may be strategically used in assessments because

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they are important in determining the movement of contaminants, they can be readily applied, and they permit useful inferences about other factors. Though these factors show many direct and inverse relationships among each other, they are inescapably a part of any evaluation system. A careful weighting of their tendencies and countertendencies leads to optimal assessment of waste sites. (See also W87-05071) (Author's abstract) W87-05091

EVALUATION OF THE PERFORMANCE OF ZONE OF SATURATION LANDFILLS IN WIS-

CONSIN, Wisconsin Dept. of Natural Resources, Madison. Bureau of Solid Waste Management. For primary bibliographic entry see Field 5B. W87-05094

MONITORING OF GROUND WATER CONTAMINATION FROM WASTE DISPOSAL STES IN ALBERTA, CANADA, Alberta Environment, Edmonton. For primary bibliographic entry see Field 5B. W87-05095

NEW COMPOSITE LINER FOR HAZARDOUS WASTE IMPOUNDMENTS, Portland Cement Association, Skokie, IL.

W. G. Dinchak.

IN: Innovative Means of Dealing with Potential
Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water
Quality Symposium, September 26-28, 1984, Les
Vegas, Nevada. National Water Well Association,
500 W. Wilson Bridge Road, Worthington, Ohio,
1984. p 480-490, 7 fig, 8 ref.

Descriptors: *Composite liners, *Materials testing, *Waste disposal, Disposal sites, Synthetics, Cements, Cost analysis, Apalachin, New York,

A composite liner made of a synthetic membrane placed between two 6-in (152 mm) compacted lifts of soil-cement has been developed by the Portland Cement Association. Construction feasibility was or son-cement has been developed by the Portland Cement Association. Construction feasibility was demonstrated by a test section built in September 1983 near Apalachin, N.Y. Observations show no damage occurred to the membrane. The soil-cement serves as a foundation and protective cover for the membrane. This composite liner is strong, durable, and impermeable with an estimated in-place construction cost of \$1.30/sq ft (\$14/sq m). Conventional highway construction equipment is used. Soil-cement is durable having been exposed to wave action, freezing and thawing cycles, wetting and drying cycles, sea water, municipal and industrial wastewater, brine solutions, coal ash alurries, longitudinal flows, and sanitary landfull leachates. It is environmentally acceptable because usually the excavation from which the soil is obtained becomes part of the lagoon or pond and, thereby, covered with, for example, wastewater. Construction does not leave 'scars' on the environment. (See also W87-05071) (Lantz-PTT) W87-05097

5F. Water Treatment and **Quality Alteration**

WATER TREATMENT ENTERS 'A NEW ERA', For primary bibliographic entry see Field 5G. W87-04370

SOME OBSERVATIONS ON A CHOLERA OUTBREAK AT THE UMVOTI MISSION RE-SERVE, NATAL, National Centre for Ocupational Health, Johannes-

Burg (South Africa).
For primary bibliographic entry see Field 5C.
W87-04378

GIVE HEALTH A CHANCE - WITH HEALTHY SURROUNDINGS, Johns Hopkins Univ., Baltimore, MD.

For primary bibliographic entry see Field 5G. W87-04638 W87-04380

HYDRAULIC DESIGN ALGORITHMS FOR PIPE NETWORKS, Kentucky Univ., Lexington. Dept. of Civil Engi-

neering. L. E. Ormsbee, and D. J. Wood. Journal of Hydraulic Engineering JHEND8, Vol. 112, No. 12, p 1195-1207, December 1986. 1 fig, 2

Descriptors: *Hydraulic design, *Pipes, *Water distribution, *Hydraulic network equations, *Pipe networks, *Design standards, Calculations, Mathematical equations, Algorithms.

A general methodology was presented for use in the design of water distribution networks. The proposed approach was conceptually useful for certain applications. The approach was based on recasting the basic set of hydraulic network equations in terms of selected design parameters for specified operating conditions. The reformulated network equations were then solved using a modified linear method. In order to demonstrate the feasibility of the approach, two different algorithms were developed and applied to an example network. (Author's abstract) W87-04393

ESTIMATION OF THE SHARE OF EACH WATER SOURCE FOR ADULTS IN FRANCE: WATER INTAKE PROVIDED TO FRENCH

WALES
ADULTS,
BSN S.A., Paris (France).
For primary bibliographic entry see Field 6D.

QUANTITATIVE DETERMINATION OF TRACE CONCENTRATION OF ORGANICS IN WATER BY SOLVENT EXTRACTION AND FUSED SILICA CAPILLARY GAS CHROMA-TOGRAPHY: ALIPHATIC AND POLYNU-CLEAR HYDROCARBONS, National Centre for Scientific Research, Havanna

Nationa (Cuba).

For primary bibliographic entry see Field 5A. W87-04634

COMPARING CONSTANT-RATE AND DE-CLINING-RATE DIRECT FILTRATION OF A

CLINING-RATE DIRECT FILTRATION OF A SURFACE WATER, Seattle Dept. of Water, WA. D. J. Hilmoe, and J. L. Cleasby. Journal of the American Water Works Association JAWWA5, Vol. 78, No. 12, p 26-34, December 1986. 7 fig. 5 tab, 26 ref. EPA Cooperative agreement CR 808837-01-0.

Descriptors: *Comparison studies, *Filtration, *Water treatment, *Chemical treatment, *Surface water, *Coagulation, Performance evaluation, Polymers, Alum, Effluents, Turbidity, Particulate matter, Bacteria, Coliforms, Head loss, Water qual-

ity.

The need for adequate treatment of the water supplies of small communities has been amply demonstrated by several outbreaks of waterborne giardiasis and other diseases of bacterial or undetermined etiology. These outbreaks have shown that the practice of providing only chlorination for high quality surface waters is not sufficient. More than one barrier to disease transmission is needed to make these small systems reliable. Pilot-scale constant-rate and declining-rate direct filtration systems were evaluated for treating a high quality surface water, using two flow rates and alum or cationic polymer as the primary coagulant. Turbidity, particle count, and total coliform count were used to compare filtrate qualities. It was found that the effluent qualities for the two filtration schemes were the same-a result that disagrees with the conclusions of a previous study that used limesoftened groundwater. However, the results of the current study were consistent with those of past projects in that the rate of head loss increase was the same for both types of filters. (Alexander-PTT)

DESIGN AND OPERATION OF A SLOW SAND FILTER, T. J. Seela

FILITER,
T. J. Seelaus, D. W. Hendricks, and B. A. Janonis.
Journal of the American Water Works Association
JAWWA5, Vol. 78, No. 12, p 35-41, December
1986. 3 fig. 5 tab, 7 ref. AWWA Research Foundation Contract 80-84.

Descriptors: *Design standards, *Slow sand filters, *Filtration, *Water treatment, *Effluents, Performance evaluation, Turbidity, Particulate matter, Raw water, Sand beds, Giardia cysts, Microorganisms, Surface water, Maintenance, Water quality.

The design experience at Empire, Colo., and the postdesign evaluation have provided knowledge about the efficiency of the slow sand filtration process at full-scale and the basis for recommendations concerning slow sand filtration practice. Operation of the filter required daily inspection pleasurement of water depth and effluent turbidity, along with monthly scraping. Scraping required only two workhours, however, and only 0.2 in. (0.5 cm) of surface was removed. The projected life of the sand bed at this rate of removal is 15 years, with a residual depth of 1 ft (0.3 m). Giardia cysts were found in the raw water on five occasions, but none were found in the finished water. Microscopic organisms and particles were found in the raw water found in the raw water of the raw water the raw water but either zero or rare numbers were found in the finished water. (Author's abstract) W87-04639

RAPID RATE FILTRATION OF LOW TURBID-ITY WATER USING FIELD-SCALE PILOT FIL-

n-Corbin and Associates, Inc., Albuquerque

NM.
R. R. Mosher, and D. W. Hendricks.
Journal of the American Water Works Association
JAWWA5, Vol. 78, No. 12, p 42-51, December
1986. 9 fig, 1 tab, 9 ref.

Descriptors: *Rapid rate filtration, *Filtration, *Water treatment, *Filters, *Turbidity, *Chemical treatment, *Coagulation, Particulate matter, Giardia cysts, Temperature effects, Water quality.

The primary objective of this research was to determine whether results obtained with laboratory-scale rapid rate filtration of low turbidity waters could be duplicated during full-scale operation. With the aid of two field-scale pilot filters, it was verified that, using proper chemical coagulation, rapid rate filtration can remove high percentages of microscopic particles, including Giardia cysts. Although low temperatures have in the past been thought to hinder the treatment of low turbidity waters, the results of this research suggest that the rapid rate filtration of low turbidity waters can be as efficient at 32 F (0 C) as at higher temperatures. (Author's abstract) (Author's abstract) W87-04640

IMPLEMENTING DIRECT FILTRATION AND

IMPLEMENTING DIRECT FILTRATION AND NATURAL FREEZING OF ALUM SLUDGE, Onondaga County Metropolitan Water Board, Syracuse, NY.

D. E. Fitch, and C. M. Ellion, Journal of the American Water Works Association JAWWA5, Vol. 78, No. 12, p 52-56, December 1996 2 5c.

Descriptors: *Direct filtration, *Filtration, *Water treatment, *Freezing, *Alum aludge, *Sludge, *Sludge conditioning, *Waste disposal, *Sludge disposal, *Land disposal, Thawing, Pollutants, Discharge, Studge lagoons,

In the early 1970s the Metropolitan Water Board, located in central New York State, was faced with two challenges: to expand the treatment capacity of its Lake Ontario plant and to dispose of process waste economically and in such a way that the requirements of its pollutant discharge permit were met. Doubling of treatment capacity was accomplished, after extensive testing, by implementing

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high-rate direct filtration, which also reduced the amount of alum sludge produced by the plant. Pilot- and full-scale testing at the plant led to construction of permanent sludge-handling facilities. This system incorporates modified retention lagoons for solids separation, initial consolidation, and storage; and a floating pump for transferring the sludge via a pipeline to a series of beds, where freezing, thaving, and decoanting concentrate the sludge substantially, making it suitable for land application by standard earth-moving equipment. (Author's abstract) high-rate direct filtration, which also reduced the application 8 (Author's ab W87-04641 itract)

EFFECTS OF CATIONIC POLYELECTRO-LYTES ON THE REMOVAL OF SUSPENDED PARTICULATES DURING DIRECT FILTRA-

TION, Southern California Metropolitan Water District,

Southern Carrier M. Pirbazari.
T. S. Tanaka, and M. Pirbazari.
Journal of the American Water Works Association
JAWWA5, Vol. 78, No. 12, p 57-65, December
1986. 10 fig. 4 tab, 18 ref.

Descriptors: *Filtration, *Polymers, *Polyelectrolytes, *Suspended solids, *Water treatment, *Chemical treatment, Turbidity, Kinetics, Osmometry, Chromatography, Adsorption, Statistical analysis, Mixing.

Filtration is recognized as a critical process in the removal of suspended particulates from drinking water. Because of the National Interim Primary Drinking Water Regulations of December 1975, which mandated a maximum contaminant level for turbidity, direct filtration designs have advanced to the forefront of candidate treatment methodologies in terms of feasibility and economy. This research in terms of feasibility and economy. This research investigated the important parameters influencing the degree of particulate removal from low turbidity water in a configuration that included rapid mixing followed by filtration. The varied parameters were rapid-mixing velocity gradient, cationic polyelectrolyte type, and polyelectrolyte dosage. The cationic polyelectrolytes were characterized for molecular weight by membrane osmometry, light scattering, and high performance liquid chromatography. The filtration kinetics variables, including maximum depth-averaged single-collector matography. The filtration kinetics variables, in-cluding maximum depth-averaged single-collector efficiency and specific deposit, were used to char-acterize the efficiency of particulate removal for each of 72 filter runs. Statistical analyses demon-strated that the choice of polyelectrolyte was the only significant factor. Additionally, volume size distribution analyses of particle count data from in-depth samples in the filter demonstrated that the polyelectrolyte configuration may be critical for adsorption of polyelectrolytes to particulates and media in filtration. (Alexander-PTT) W87-04642

PREDICTING THE EXPANSION BEHAVIOR OF FILTER MEDIA, Bolton and Menk, Inc., Mankato, NM. A. H. Dharmarajah, and J. L. Cleasby. Journal of the American Water Works Association JAWWA5, Vol. 78, No. 12, p 66-76, December 1986. 19 fig, 8 tab, 20 ref.

Descriptors: *Model studies, *Filter media, *Filtration, *Waster treatment, *Wastewater treatment, *Performance evaluation, *Fluidization, Head loss, Particle size, Correlation analysis.

As a result of the growing importance of granular media filtration in water and wastewater treatment, several studies dealing with various aspects of fluidization have been reported in the literature during the past two decades. The sphericity or angularity of the different filter media currently being used shows much variation and greatly influences the fixed bed head loss, the minimum fluidization velocity, and the expansion behavior of the media. Models that have been used to predict the expansion of filter media are evaluated, and a new correlation, which represents an alternative approach to describing the velocity-voidage relationship of particulately fluidized systems, is explained. The uses and limitations of this correlation are included. (Alexander-PTT)

ACTION OF OZONE ON TROPHOZOITES AND FREE AMOEBA CYSTS, WHETHER PATHOGENIC OR NOT,

PATHOGENIC OR NOT, Trailigaz Co., Garges-les-Gonesse (France). Re-search and Applications Div. B. Langlais, and D. Perrine. Ozone: Science and Engineering OZSEDS, Vol. 8, No. 3, p 187-198, Summer 1986. 1 fig. 4 tab, 21 ref.

Descriptors: *Ozone, *Ozonation, *Trophozoites, *Amoeba, *Cysts, *Water treatment, *Wastewater treatment, *Disinfection, *Pathogens, Surface water, Groundwater, Recreation, Bactericides, Virucides, Inactivation.

Numerous research studies demonstrate that free Numerous research studies demonstrate that tree amoeba are protozoans apparently capable of colonizing a very large number of media. At the present time, unfortunately, it remains difficult for specialists in amoebic ecology to pinpoint clearly the microbiological and physico-chemical factors capable of explaining the presence or absence of capable of explaining the presence or absence of free amoeba in one medium or another, particular-ly free amoeba pathogenic for man. Owing to the presence of free living amoeba - some of which are pathogenic to man - in any aqueous medium (before or after traditional treatment processes in surface water, groundwater, swimming pools, etc.), the task was to test the efficiency of ozone as a disinfecting agent if was begun by studying the a disinfecting agent. It was begun by studying the ozonation process, in bactericidal and virucidal ozonation process, in bactericidal and virucidal conditions, on cysts of eleven free living amoeba strains. Most of the tested strains were destroyed under less drastic conditions than those arising from true ozonation (0.4 mg/L of dissolved ozone residual maintained for 4 minutes) and it was attempted to find the ozonation parameters (dissolved ozone residual and contact time) just necessary to obtain inactivation of the cysts under laboratory conditions. In the same way, ozone efficients sary to obtain inactivation of the cysts under laboratory conditions. In the same way, ozone efficiency on eight strains of trophozoites was studied. True ozonation destroyed all the trophozoites of the tested strains. Weaker ozonation conditions showed variations in sensitivity between different strains. (Alexander-PTT) W87-04644

ARE THE RESULTS OF OZONATION OF MODEL COMPOUNDS AT HIGH CONCENTRATIONS TRANSFERABLE TO THE CONDITIONS OF DRINKING WATER TREATMENT

WITH OZONE, Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). C. Gauducheau, E. Gilbert, and S. H. Eberle.

Ozone: Science and Engineering OZSEDS, Vol. 8, No. 3, p 199-216, Summer 1986. 13 fig, 3 tab, 14

Descriptors: *Ozonation, *Model studies, *Organic compounds, *Ozone, *Drinking water, *Water treatment, *Pate of pollutants, *Pollutant identification, *Chemical treatment, Oxidation, Adsorption, Chemical reactions, Phenols, Pollution load,

Organic compounds of the different classes of substances (isobarbituric acid, citraconic acid, and ochlorophenol) were ozonized while varying their nitial concentrations at pth 7. In the case of isobarbituric acid at .001 mol/L, formyloxaluric acid, oxaluric acid, and formic acid were identified. At an initial concentration of .00001 mol/L, alloxanic acid and oxalic acid were formed in addition to oxaluric acid and formic acid. In both cases, the rates of elimination are similar. After ozonation of citraconic acid (c = .001 mol/L, pH 7), the following oxidation products were identified: glyoxylic, acetic, formic, oxalic, pyruvic, and hydroxypyruvic acids. At the initial concentration of .00001 mol/L, the rate of elimination is half the value of the rate at .001 mol/L. Contrary to the ylic, acetic, formic, oxalic, pyruvic, and hydroxy-pyruvic acids. At the initial concentration of .00001 mol/L, the rate of elimination is half the value of the rate at .001 mol/L. Contrary to the results obtained at .001 mol/L, even after a long ozonation time, only 70% of the initial compounds were destroyed. Also fewer oxidation products, glyoxylic, acetic, oxalic, and pyruvic acids, were formed. The rate of elimination of o-chlorophenol at c = .0001 mol/L is twice as fast as at an initial concentration of .001 mol/L. In both cases yellow

compounds are formed (adsorption at 400 nm) as primary oxidation products. After 70% elimination of o-chlorophenol, the yield of these compounds at an initial concentration of .00001 mol/L is twice as high as in the case of an initial concentration of .001 mol/L. The different results obtained which are dependent on the initial concentration are ex-plainable by different reaction mechanisms, direct ozone attack and oxidation by (OH). (Author's

INFLUENCE OF AN OZONE, CHLORINE AND CHLORINE DIOXIDE TREATMENT ON MU-CHLORINE DIOXIDE INEAIMENT ON MOTAGENIC ACTIVITY IN (DRINKING) WATER, Rijksinstituut voor de Volksgezondheid en Milieuhygiene, Leidschendam (Netherlands).
H. J. Kool, and J. Hrubec.
Ozone: Science and Engineering OZSEDS, Vol. 8, No. 3, p 217-234, Summer 1986. 4 fig. 3 tab, 48 ref.

Descriptors: *Mutagenic activity, *Ozone, *Chlorine, *Chlorine dioxide, *Drinking water, *Water treatment, *Pate of pollutants, *Water pollution effects, *Disinfection, Organic compounds, Organochlorine compounds, Ames test, Hydrocarbons, Comparison studies.

Comparison studies.

Drinking waters which are prepared from surface waters generally receive a chlorine disinfection treatment in The Netherlands. It was shown that trihalomethanes (THMs), including the animal carcinogen chloroform, were introduced in drinking water with this treatment. Three disinfectants, viz. chlorine, chlorine dioxide. and ozone, were compared with respect to the formation of organic mutagens and halogenated organic compounds in drinking water. Chlorine increased the mutagenic activity (Ames test) drastically, as well as the level of halogenated organics. High chlorine dioxid doses (5 - 15 mg/L Cl02) also showed a drastic increase of mutagenic activity, while relatively low doses of chlorine dioxide (<5 mg/L Cl02) in most cases showed no effect or a slight increase in the level of halogenated organics was observed after this treatment. An ozone treatment (3 mg/L 03) showed a slight increase in mutagenic activity, while a treatment with 10 mg/L 03 completely reduced the activity. The level of volatile halogenated hydrocarbons was not altered, while the level of non-volatile halogenated hydrocarbons seemed to decrease after an ozone treatment. (Alexander-PTT) exander-PTT)

TUBE DIAMETER AND HEIGHT INFLUENCE ON THE OZONATION OPERATING CONDI-TIONS WITH A U-TUBE,

TIONS WITH A C-TUBE,
Centre de Recherche Lyonnaise des Eaux - Degremont, Le Pecq (France).
E. Brodard, J. Mallevialle, C. Coste, and M.

Ozone: So

Ozone: Science and Engineering OZSEDS, Vol. 8, No. 3, p 235-246, Summer 1986. 7 fig, 2 tab, 8 ref.

Descriptors: *Ozonation, *Water treatment, *Ozone generators, Optimization, Performance evaluation, Oxidation, Energy, Disinfection, Viruses, Bacteria, Kinetics, Paris, France.

Ozone has been used for a number of years in water treatment for virucidal and bactericidal action, as well as for its oxidizing properties. Energy consumption during its use depends on the performance of the ozone generators, but also on the ozone transfer efficiency from the gas phase to the liquid phase. Therefore, it is important to use a contactor with a high transfer efficiency. A new ozonation reactor has been developed: the Deep U-Tube (DUT). This reactor works under preserve, which increases the saturation concentration of ozone at equilibrium and creates a great turbulence, which breaks the gas bubbles and increases the interfacial area of exchange. Further, this new contactor has a piston hydraulic behavior in the liquid phase, which leads to a very great efficiency and to a better reduction for all reaction kinetics. A pilot U-tube was constructed in the western A pilot U-tube was constructed in the western Paris region in France. It is 31-m in depth and 0.2-m in diameter. The most important operating con-

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ditions for optimization are the depth of the tube (between 13 and 31 m), the velocity of water in the internal tube (between 0.6 and 2.5 m/sec), the gas/liquid ratio (between 2.5 and 25%), and the concentration of ozone in the gas (between 5 and 25 g/cu m). These results show that the most important parameter is the gas/liquid ratio, which must be less than 15% in order to have the best transfer yields (> 85%). A 20-m deep U-tube is sufficient for transfer of ozone into water. The fluid velocity in the interior tube has no effect on this transfer efficiency. The maximum quantity of ozone transferred is on the order of 4 g/cu m. This reactor then can be utilized with a large number of very different waters. This new contactor, very efficient for the transfer of ozone into water, is a future reactor for a great number of reactions which put into play the exchange of gas to liquid. (Author's abstract)

POTENTIAL USE OF OZONE AND PEROXI-DASE FOR REMOVAL OF AROMATIC COM-POUNDS FROM WATER BY POLYMERIZA-TION,

TION, Centre de Recherche Lyonnaise des Eaux - Degre-mont, Le Peoq (France). J. P. Duguet, B. Dussert, A. Bruchet, and J. Mallevialle. Ozone: Science and Engineering OZSEDS, Vol. 8, No. 3, p 247-260, Summer 1986. 8 fig. 3 tab, 12 ref.

Descriptors: *Ozone, *Enzymes, *Peroxidase, *Aromatic compounds, *Water treatment, *Fate of pollutants, *Polymerization, *Chemical treatment, *Pollutant identification, Oxidation, Organic compounds, Potable water, Chromatography, Spectral analysis, Polymers.

Natural or synthetic organic compounds usually are present in raw waters at low concentrations are present in raw waters at low concentrations (ng/L to microgram/L). Even at low concentrations these compounds may cause taste and odor problems, or represent a health risk based on toxic and mutagenic considerations. These compounds are not entirely removed on conventional treatment of potable water. One means of increasing the removal efficiency is to use new processes based on the polymerization of these compounds. Oxidation of organics by ozone has been the object of extensive studies. A great number of these concern the aromatic ring cleavage, but polymerization by extensive studies. A great number of these concern the aromatic ring cleavage, but polymerization by ozone or enzyme, such as peroxidase, was not greatly studied. The effects of ozone or enzyme on the polymerization of dichlorophenol, under the conditions of potable water treatment are studied using HPLC, scintillation counting, exclusion conditions of potable water treatment are studied using HPLC, scintillation counting, exclusion chromatography, and GC-MS. These techniques permit the characterization and identification of polymers. These first results indicate that polymer-ization techniques may be useful water treatment methods. (Alexander-PTT) W87-04648

IMPROVEMENT OF OZONE OXIDATION AND DISINFECTION DESIGN, Societe Degrenont, Rueil-Malmaison (France). Y. R. Richard.

Ozone: Science and Engineering OZSEDS, Vol. 8, No. 3, p 261-273, Summer 1986. 7 fig, 31 ref.

Descriptors: *Ozone, *Ozonation, *Disinfection, *Water treatment, *Chemical treatment, *Wastewater treatment, Design standard, Organoleptic properties, Treated water, Potable water, Virus inactivation, Oxidation, Kinetics.

For a long time, the aim of ozonation has been the improvement of the organoleptic qualities of treated water. Disinfection, and particularly virus inactivation, also has been a reason for introducing ozonation steps in the treatment line of a potable water treatment plant. Other purposes of ozonation hen have been developed in different fields of application, such as iron and manganese removal, micropollutants oxidation, urban wastewater disinfection, coagulant and flocculant aids, and improvement of biological treatment. During the last few years, numerous studies have been concerned either with the kinetics of ozonation reactions, or the modelling of contact systems. A better fit be-

tween these two factors should be found. The designer of a plant has to consider all the purposes of ozonation along the treatment line to determine the best solutions, both as concerns the different points of application and the different types of contactors to be used. Some laboratory tests can help make this choice. (Author's abstract) W87-04649

CHLORINATION OF 4-HYDROXYCINNAMIC ACID AND ITS TOXIC RISK AS A NATURAL OCCURRING WATER CONTAMINANT, Reading Univ. (England). Dept. of Physiology and Biochemistry.

Descriptors: *Bioassay, *Water treatment, *Water pollution sources, *Phenolic acids, *Chlorination, *4-Hydroxycinnamic acid, *Water pollution effects, Chemical reactions, Escherichia coli, Bacteria, Toxicity, Pollutants, Organochlorine com-

When plant material decays a number of phenolic compounds are released into the environment some of which are potentially hazardous water contaminants. The chemical behavior of the plant-derived phenolic acids under conditions similar to the routine water chlorination was studied. The toxicity of the chlorophenolic mixtures formed was assessed on a Eacherichia coli strain similar to that found in the human intestine. Assuming an average of 380 microgram extractable 4-hydroxycinnamic acid per liter tap water, the concentration must rise 3000 times to show acute oral toxicity. The results suggested that there is no immediate risk for the E. coli flora in the human intestine though it is cautioned that the effects of long term exposure to low concentrations have not been studied, nor has the relationship of these contaminants to other pollutants been explored. (Wood-PTT)

REVIEW OF MODELS DEVELOPED TO PREDICT GASEOUS PHASE ACTIVATED CARBON ADSORPTION OF ORGANIC COMPOUNDS,
Texas Univ. Health Science Center at San Antonio. School of Public Health
M. D. Werner, and N. L. Winters.
CRC Critical Reviews in Environmental Control
CCECAU, Vol. 16, No. 4, p 327-356, 1986. 4 fig. 1 tab. 126 ref.

Descriptors: "Air treatment, "Water treatment, "Model studies, "Activated carbon, "Adsorbents, Organic compounds, "Reviews, "Adsorption, "Mathematical models, Mathematical studies, Mathematical equations, Breaththrough curves, Prediction, Isotherms.

Activated carbon adsorption is an important control process for treating air contaminated by organic compounds. Like other engineering processes, rational methods are essential for reliable and economically effective design and operation of a gaseous phase adsorption process. Current methods and recent development concerning successful design and operation were reviewed. Methods to predict the adsorption capacity of the carbon, dispersion of the contaminant breakthrough curve, adsorption of organic mixtures, and adsorption from humid air were included. Development of predictive models, including assumptions, was presented and critically analyzed. Comparisons of actual adsorption data and predicted values were made when the information was available. (Autor's abstract)

PROGRAMMING A MINICOMPUTER FOR LIUQID LEVEL CONTROL IN A WATER

Kuwait Univ., Safat. Coll. of Engineering and Petroleum. M. F. Abd-el-Bary, M. F. Hamoda, and S. Curreri. Journal of Environmental Science and Health (A)

JESEDU, Vol. 21, No. 7, p 625-637, October 1986. 3 fig, 1 tab, 6 ref.

Descriptors: *Automation *Computers, *Liquid level, *Water treatment, *Performance evaluation, *Mathematical studies, *Water tanks, *Wastewater treatment, *Computer programs, *Fortran, *Water level, Linear control algorithm, Algorithms.

Many of the tanks employed in automatic water and wastewater treatment require liquid level control. A Fortran computer program written for liquid level control using a Digital MINC-II minicomputer is presented. A short sampling time, a first order system adequately describe the process. At longer sampling periods, the closed loop system response shows overshoot and oscillations. A first order system with a delay time of 2.0 seconds for the process, can predict such behavior. The discrepancy between the theoretical and experimental values is attributed to the aluggishness of the valve. Appropriate mathematical equations, parameters, and the program are presented. (Wood-PTT) W87-04688

DESALINATION OF SEA-WATER AND BRACKISH WATER: THE CURRENT STATE OF THE ART AND A REVIEW OF PROBLEMS AND FUTURE DEVELOPMENTS, For primary bibliographic entry see Field 3A. W87-04784

PUBLIC RELATIONS FOR THE PUBLIC WATER SUPPLY IN YEARS TO COME,

Aqua AQUAAA, No. 5, p 251-254, 1986. 1 fig.

Descriptors: *Public relations, *Public opinion, *Water distribution, Future planning, Electronic

Changing public relations needs of public water authorities since 1969 when public relations was first included as an International Water Supply Association Congress topic are discussed. Among the developments since then are the broadening of public relations needs from simple conservation and safety warnings to broader publicity functions performed by professionals, the growth in size of water suppliers, the need to mobilize public sympathy for protection of raw water supplies, the rise of a more demanding consuming public, and the increased competition for attention in electronic media. (Rochester-PTT)

WATER METERS AND METERING - THE STATE OF THE ART AND FUTURE DEVEL-

Aqua AQUAAA, No. 5, p 255-258, 1986.

Descriptors: *Measuring instruments, *Pricing, *Economic aspects, *Prices, *Water metering, *Remote sensing, United States, Japan, Construction materials, Technology.

Many authorities that had previously used an inclusive price for water (no metering) now seem to
be considering changing to metering, even though
this represents a substantial initial cost. Meters
themselves have undergone many changes, particularly in the area of substituting plastic parts for
metal ones. This change has reduced the relative
advantage of volume-measuring over velocity
meters at small discharges. Meters designed to read
either high or low flow rates (compound meters)
have been much improved and are gaining wider
acceptance. Remote reading of meters is not
widely practiced worldwide, but is being installed
by several large urban systems in the USA and
Japan, where the technology is now well beyond
the experimental stage. (Rochester-PTT)

WATER QUALITY AND TREATMENT - THE STATE OF THE ART AND DEVELOPMENTS IN FUTURE,

Group 5F-Water Treatment and Quality Alteration

Agua AOUAAA, No. 5, p 259-262, 1986.

Descriptors: *Water quality management, *Pollution control, *Water treatment, Disinfection, Floculation, Ion exchange, Stripping, Biological treatment Groundwater manag

Problems of water quality, particularly with respect to inorganic and organic contaminants are summarized, and the following different techniques of water purification are discussed: disinfection, floculation, adsorption, ion exchange, stripping, biological treatment, and groundwater protection. (Rochester-PTT)
W87-04787

MANAGEMENT OF WATER RESOURCES - ROLE OF THE WATER SUPPLIERS, C. Gomella.

Aqua AQUAAA, No. 5, p 263-267, 1986.

Descriptors: *Forecasting, *Water management, *Management planning, Water cycle, Desalination, Policy making, Mathematical models.

The problems of forecasting and managing water supplies are discussed, including a discussion of primitive attitudes towards the water cycle, desaination and its value, the role of the rational planner in community policy making, the role of the polluter from the point of view of water suppliers, and mathematical modeling and its role in water management. (Rochester-PTT)

DISTRIBUTION AND TRANSPORTATION OF WATER - THE PRESENT STATE OF THE ART AND A LOOK INTO THE FUTURE, R. J. Labum.

Aqua AQUAAA, No. 5, p 268-272, 1986.

Descriptors: *Management planning, *Water distribution, *Water conveyance, Reticulation.

Distribution and reticulation of water from the source, which could be some distance from where it is needed, and conveyed by canals and pipelines to treatment plants and to pumping systems and distribution systems including reservoirs and reticulation systems, requires a considerable and varied engineering input. The future water supply thus rests very much in the hands of the water engineer, assisted by many allied disciplines. Although there are many aspects of water supply, such as quality, treatment, public relations, and finance, which should receive due attention, the International Water Supply Association suggests they will fail if adequate attention is not given to the distribution and reticulation of water in the future. (Author's abstract)

STATE OF THE ART OF NITRATE ELIMINA-TION IN THE DRINKING WATER TREAT-MENT PROCESS,

gszentrum Karlsruhe G.m.b.H. (Ger-Kernford many, F.R.). S. H. Eberle

Aqua AQUAAA, No. 5, p 273-274, 1986.

Descriptors: *Water treatment, *Groundwater pol-lution, *Nitrates, *Biological treatment, *Ion ex-change, *Reverse osmosis, *Wastewater treatment, Toxins, Bacterial physiology.

The origin and development of nitrate concentra-tions in natural waters, especially ground waters, has been discussed since the 1970a. The best solu-tion to the problem would be to prevent inputs to the groundwater, but this can be achieved only after many years. The technologies available for removing nitrate may be classified as either biolog-ical or physico-chemical. Biological systems de-stroy the nitrate definitively but tend to fluctuate in performance and are sensitive to bacterial toxistroy the nitrate definitively but tend to fluctuate in performance and are sensitive to bacterial toxicants. The physico-chemical processes, such as ion exchange and reverse osmosis, do not destroy the nitrate, but produced a concentrate - a waste water. On the other hand, they are well established in water technology and are easily controlled.

W87-04790

CARIX(R) PROCESS FOR REMOVING NITRATE, SULPHATE, AND HARDNESS FROM WATER,

WABAG G.m.b.H. and Co. KG, Kulmbach (Ger-

many, F.R.).
K. Hagen, W. Holl, and W. Kretzschmar.
Aqua AQUAAA, No. 5, p 275-278, 1986. 4 fig, 10 ref.

Descriptors: *Water treatment, *Hardness, *Nitrate, *Sulfates, *Ion exchange, *CARIX process, *Carbon dioxide, *Water softening, *Cost analysis, Germany, Demineralization, Pilot plants.

The principle of the CARIX process, the characteristic features of a CARIX plant, and results of pilot and large-scale employment of this technique are described. The CARIX process employs the are described. The CARIX process employs the principle of ion exchange processes to accomplish a partial softening of the water and the removal of nitrate and sulfate. The required reactions are carried out with a weakly acidic exchanger in the acid form and an anion exchanger in the HCO3(-) form. Both exchangers are employed together in a mixed bed and are regenerated together in one operation with carbon dioxide. The process has been tested in a pilot plant in several waterworks using a mobile CARIX plant. It provided economical partial demineralization of drinking water. The first centralized large plant for softening water and reducing the nitrate content was constructed at Bad Rappenau (Federal Republic of Germany) and started operation in January 1986. The plant was conceived for a throughput of 170 cu m/hr. The cost of treating raw water in the CARIX plant amounts to 0.51 Deutschmarks/cu m. (Rochester-PTT) PTT) W87-04791

SEPARATION OF NITRATE FROM WELL WATER BY MEMBRANE PROCESSES (RE-VERSE OSMOSIS/ELECTRODIALYSIS RE-

VERSAL), Technische Hochschule Aachen (Germany, F.R.). 1echnische Hochschule Aachen (Germany, F.R.). Inst. fuer Verfahrenstechnik. R. Rautenbach, W. Kopp, R. Hellekes, R. Peters, and G. Van Opbergen. Aqua AQUAAA, No. 5, p 279-282, 1986. 6 fig, 1 tab, 3 ref.

Descriptors: *Well water, *Reverse osmosis, *Electrodialysis, *Evaporation, *Nitrates, *Water treatment, *Cost analysis, Silica scaling, Organic compounds, Energy, Performance evaluation.

The principles and economics by reverse osmosis (RO) and electrodialysis reversal (EDR) are described. EDR is appropriate for situations where the brine resulting from RO must be treated; it has definite advantages compared to a second RO stage. EDR as a second stage behind RO (a 'zero-discharge' process) has cost advantages over evaporation (EV) of the concentrate on membrane stages. Alternatively, EDR can be employed for the separation of nitrate and, simultaneously, for the production of a highly concentrated retentate. For nitrate reduction, RO has advantages of simple design, easy membrane exchange, and rejection of suspended particles and organic compounds and disadvantages are possible silica scaling and great sensitivity to scaling. EDR has higher recovery rates, but a complex arrangement (three fluid circuits) and tendency to H2-formation and high specific power consumption. Comparison of cuits) and tendency to H2-formation and high specific power consumption. Comparison of RO+EDR+EV, RO+ion exchange+EDR+EV, and EDR+EV indicates that EDR+EV has the lowest specific cost to yield nitrate concentrations in the product of about 25-50 mg/l. (Rochester-PTT)

NITRATE ELIMINATION WITH HETEROTROPHIC AQUATIC MICROORGANISMS IN FIXED BED REACTORS WITH BUOYANT CARRIERS,

Preussag A.G. Erdoel und Erdgas, Hanover (Germany, F.R.).
K. W. Roennefahrt.

Aqua AQUAAA, No. 5, p 283-285, 1986. 4 fig, 1 tab, 4 ref.

Descriptors: *Water treatment, *Nitrates, *DENI-POR process, *Biological water treatment, *Fixed bed reactors, *Buoyant carriers, *Cost analysis, Bacteria, Hydrogen ion concentration, Temperature, Oxidation, Organic compounds, Ethanol,

Groundwater.

The DENIPOR process for treating drinking water employs reduction of nitrate to nitrogen by heterotrophic bacteria with simultaneous oxidation of organic substances. It relies upon expanded polystyrene spheres of diameters varying from 10 mm to 2-3 mm, which have surface areas of about 90 sq./cu m, respectively. Ethanol is the preferred substrate. Temperature and pH strongly affect the biochemical processes in the reactor. A complete DENIPOR plant uses a fourstage process (pretreatment, DENIPOR reactor, and two aeration steps in series). The system is capable of 95/90% elimination of nitrate-N and reduces total organic carbon to a lower value than in the original influent groundwater. The cost of energy is about 0.02 Deutschmarks (DM)/c ur m and the cost of substrate and other chemical is about 0.10-0.20 DM/cu m. The largest part of the cost is the capital cost of building the plant; this depends less on the total throughput of water than on the amount of N that has to be eliminated. (Rochester-PTT)

BIOLOGICAL DENITRIFICATION PROCESS WITH HYDROGEN-OXIDIZING BACTERIA FOR DRINKING WATER TREATMENT, Sulzer Wasser und Abwassertechnik, Butzbach

Germany, F.R.).
H. Gross, and K. Treutler.
Aqua AQUAAA, No. 5, p 288-290, 1986. 3 fig, 2 tab, 5 ref.

Descriptors: *Drinking water, *Denitrification, *Denitropur process, *Raw water, *Pilot plants, *Biological water treatment, *Nitrates, *Cost analysis, *Water treatment, Germany, Chlorides, Bicarbonates, Hydrogen ion concentration, Bacteria, Oxidation, Microorganisms, Groundwater.

Oxidation, Microorganisms, Groundwater.

The principles of the Denitropur process, which denitrifies raw water with hydrogen-oxidizing microorganisms, its process engineering fundamentals, the results of pilot studies, and the Denitropur plant at Monchengladbach (Federal Republic of Germany) are described. Typical results of pilot studies showed reduction of nitrate in groundwater from 50 mg/1 to 5 mg, with no change in chloride, some reduction in oxygen demand and bicarbonate, an increase in bacterial counts, and no change in pH. Initial results with the Monchengladbach plant showed reduction in groundwater nitrate from <5 to <1 mg/l, nitrite from <0.02 to <0.01 mg/l, no change in total hardness, an increase in carbonate hardness from <1 to <4 mg/l, and an increase in pH from 5.4 to 6.8. The cost of the process, using a plant of normal construction (i.e., without the cost of devices used in the research program), and taking investment and operating costs into account amount to 0.3 Deutschmarks/cu m of drinking water. (Rochester-PTT)

EPIDEMIOLOGY AND EARLY DIAGNOSIS OF PRIMARY LIVER CANCER IN CHINA, Guangxi Medical Coll., Nanning (China). For primary bibliographic entry see Field 5C. W87-04820

SAFE DRINKING WATER LAW TOUGHENED, Environmental and Energy Study Inst., Washing-For primary bibliographic entry see Field 6E. W87-04823

OBSERVATIONS ON A MICROBIAL CELLU-LOSE DEGRADATION PROCESS THAT DE-CREASES WATER ACIDITY, Canada Centre for Mineral and Energy Technolo-

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Treatment and Quality Alteration—Group 5F

gy, Ottawa (Ontario). For primary bibliographic entry see Field 5D. W87-04855

TREE THAT PURIFIES WATER. CULTIVATING MULTIPURPOSE MORINGACEAE IN THE SUDAN,

Deutsche Gesellschaft fuer Technische Zusammenarbeit G.m.b.H., Eschborn (Germany, F.R.). Section for Water Supply and Sanitation. For primary bibliographic entry see Field 5G. W87-04887

WATER SYSTEMS STANDARDS SURVEY, Austin Water and Wastewater Utility, TX. S. D. Rhoades.

 D. Rhoades.
 Journal of the American Water Works Association JAWWAS, Vol. 78, No. 11, p 30-34, November 1986. 1 fig, 1 tab.

Descriptors: "Water conveyance, "Standards, "Design standards, "Engineering, "Planning, Management planning, Utilities, Pipes, Pipelines, Water use, Storage, Information exchange, Costs, Water transport.

An informal inquiry of 24 cities about local water system standards resulted in a mini-survey of criteria used for engineering and planning purposes. Areas covered were standards for sizes and types of pipes used, spacing of pipeline grids, calculations of water use for residences, velocity and pressure of distributed water, costs for pipe laid, head-loss standards, fire flow standards, and storage requirements. The exchange of such information indicated a need for a nationwide data base for water utility planning and engineering purposes that can be accessed locally using microcomputers. (Author's abstract)
W87-0403

RESTORING THE FLOW OF A FINISHED WATER PIPELINE,

Onondaga County Metropolitan Water Board, Clay, NY. D. E. Fitch, and G. R. McCollum.

D. É. Fitch, and G. R. McCollum.

Journal of the American Water Works Association

JAWWA5, Vol. 78, No. 11, p 35-38, November

1986 1 for

Descriptors: *Water pollution effects, *Water conveyance, *Maintenance, *Pipelines, *Water treatment, *Water distribution, *Cleaning, Water demand, Floculation, FlowAluminum, Alum, Conveyance structures, Pipes, Water transport.

Conveyance structures, Pipes, Water transport.

Large doses of alum used for flocculation by the Onondaga County (NY) Water Board caused a build-up of aluminum and silicone oxides on the interior of large distribution pipes. Flow was restricted to the point that supplying demand during peak usage might have become a problem. Planning for a pigging operation was begun in 1983, and the job was successfully undertaken on the Memorial Day weekend of the following year without disrupting production of a major industrial user. The pigging operation is described. Four pigruns were accomplished. Before cleaning, the clear water pumps operated at a delivery rate of 34 mgd at 170 ft total head loss. After cleaning, the same rate could be maintained at 128 ft of head loss, resulting in an approximate annual power saving of \$80,000. It is concluded that periodic cleaning of the pipeline would be more cost-effective than attempting to reduce residual aluminum levels in the finished water below current levels of 0.05-0.10 mg/l. (Author's abstract)

WATER CONTAMINATION CAUSED BY GAS-OLINE PERMEATING A POLYBUTYLENE PIPE.

PIPE, Tallahassee Water Quality Lab., FL. For primary bibliographic entry see Field 5B. W87-04905

ECONOMICS OF REMOTE METER READING.

Northern Illinois Water Corp., Champaign. R. S. Shierry. Journal of the American Water Works Association Journal JAWWA5, Vol. 78, No. 11, p 44-46, November 1986. 3 tab.

Descriptors: *Economic aspects, *Water conveyance, *Cost-benefit analysis, *Measuring instruments, *Remote meter reading, Technology Maintenance Costs.

Gaining access to residences to read water meters is difficult in Champaign-Urbana, IL, where unusually large numbers of students and other residents move in and out of apartments and houses frequently. The Northern Illinois Water Corporation's Champaign-Urbana Division therefore decided to undertake a program to install remote meter-reading equipment on all meters, beginning in 1981. The economic considerations are discussed as well as the success of the program to date. The cost of owning and maintaining one unit in 1984 was \$11.34, with a savings of \$5.66 per unit. Benefits include a decrease in inspections resulting from high bills (from 1,600 in 1974 to 196 in 1985), and the fact that telephone calls and service orders generated because of meter reading problems have become almost nonexistent. (Author's abstract)

EVALUATING RELATIVE STRINGENCIES OF EXISTING AND PROPOSED MICROBIOLO-GICAL MCLS,

K. W. Dempsey, and W. O. Pipes. Journal of the American Water Works Association JAWWA5, Vol. 78, No. 11, p 47-54, November 1986. 7 fig. 4 tab, 10 ref.

Descriptors: *Pollutant identification, *Water analysis, *Water law, *Water quality standards, *Mathematical models, *Sampling, *Indicators, *Coliforms, *Model studies, *Water quality management, Water properties, Monitoring, Biological properties, Bacteria, Pathogenic bacteria, Water pollution.

A mathematical model was used to calculate the effects of sample volume and number of samples collected each month on the probability of detecting coliforms in water distribution systems containing various levels of contamination, and to compare proposed frequency-of-occurrence maximum contaminant level rules with existing microbiological rules. The number of samples examined appeared to have a profound effect on the stringency of a frequency-of-occurrence rule; systems containing borderline levels of contamination are more likely to meet the rule if only a few samples are collected each month. It is concluded that a frequency-of-occurrence rule with a coliform density limit of 1/100 mL, instead of the current 4/100 mL, would be much closer in stringency to the existing average-density rule. (Author's abstract) W87-04907

TEST PROCEDURES FOR DETERMINING CAVITATION LIMITS IN CONTROL VALVES, Utah Water Research Lab., Logan.
W. J. Rahmeyer.

W. J. Rahmeyer.

Journal of the American Water Works Association

JAWWA5, Vol. 78, No. 11, p 55-58, November

1986. 4 fig. 1 tab, 9 ref.

Descriptors: *Testing procedures, *Control systems, *Valves, *Cavitation, *Design standards, *Conduits, *Water conveyance, Standards, Flow, Water transport, Mathematical equations.

The design and operation of control valves in a closed conduit system require testing of the different flow characteristics of the valves under experimental conditions. Different testing standards and recommended testing procedures have been published for such characteristics as pressure loss and pressure recovery. However, discussion concerning the testing procedures for cavitation and operation limits is scarce. Detailed information is presented on testing procedures and the definitions for the different cavitation limits. The effects of pressure, size, and flow coefficients are discussed, along with design equations and data for scaling

cavitation information with changes in system pressure. (Author's abstract) W87-04908

SURFACE CHEMISTRY IN WATER TREAT-MENT: REACTIONS AT THE SOLID-LIQUID INTERFACE.

Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
R. C. Bales.

Journal of the American Water Works Association JAWWA5, Vol. 78, No. 11, p 59-66, November 1986. 9 fig, 5 tab, 45 ref.

Descriptors: *Mathematical models, *Model atudies, *Solid-liquid interfaces, *Water treatment, *Chemical reactions, *Solids contact processes, *Chemical properties, *Chemical treatment, Thermodynamics, Suspended solids, Water properties, Precipitation, Coagulation, Filtration, Adsorption, Ion exchange.

Recent work in surface chemistry gives fresh insight into the rate of many surface-chemical processes in water treatment that are subject to chemical control, including dissolution, precipitation, coagulation, deposition, and surface catalysis. A common chemical step in these processes is complexation at the solid-liquid interface-attachment of a specific chemical species onto a surface of defined composition. A general surface-complexation model is presented. The rate equations are formulated in terms of the surface species involved in the rate-limiting step. This differs from rate equations for surface reactions formulated in terms of solution species by giving more direct insight into reaction stoichiometry, and because the rate equations should apply over a wider range of conditions as the effects of surface potential are explicitly accounted for in the equilibrium model. These models can be used to interpret the behavior of well-defined systems and to predict the sensitivity of systems to changes in pH, organic matter concentration, or other control variables. Use of a surface coordination-chemical approach enables directly coupling solution composition with surface behavior. (Author's abstract)

CHEMICAL PRODUCTS AND TOXICOLOGIC EFFECTS OF DISINFECTION,

EFFECTS OF DISINFECTION, Environmental Protection Agency, Cincinnati, OH. Drinking Water Research Div. B. W. Lykins, W. E. Koffskey, and R. G. Miller. Journal of the American Water Works Association JAWWAS, Vol. 78, No. 11, p 66-75, November 1986. 6 fig, 8 tab, 19 ref.

Descriptors: "Water pollution souces, "Disinfection, "Water treatment, "Water pollution effects, "Toxicology, "Chemical properties, "Chemical reactions, "Water quality management, Water properties, Chlorine, Ozone, Pilot plants, Organic compounds, Filtration, Carbon, Activated carbon, Adsorption, Drinking water, Chemical analysis, Water analysis, Membrane processes, Reverse osmosis, Comparison studies, Performance evaluation.

Four disinfectants commonly used in water treatment (chlorine, monochloramine, chlorine dioxide, and ozone) were applied to four parallel streams in a pilot plant in Louisiana. Several organics, including total organic carbon and total organic halide, were evaluated to investigate the effects of disinfection and treatment by sand filtration and granular activated carbon (GAC) adsorption. Five toxicologic tests were conducted to determine the general toxicity and the mutagenic-carcinogenic potential of disinfection or GAC adsorption. Results showed that ozonation of clarified sand-filtered water produced fewer organics than the other disinfectants studied. The short-term animal toxicologic studies revealed difficulties in analyzing drinking water for detectable toxic effects; reverse comosis was found not to be a good method for concentrating drinking water. Although in many cases the toxicological tests did not produce significant changes from the controls, an overall effect was noted with the chlorine system GAC effluent that was rechlorinated. This

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effect was more prominent as the GAC system aged. Further studies are needed to evaluate this effect because of the practice of using GAC over extended periods for taste and odor control when the GAC effluent is chlorinated. (Author's ab-

EVALUATING ACTIVATED CARBONS FOR REMOVING LOW CONCENTRATIONS OF TASTE- AND ODOR-PRODUCING ORGANICS,

University of Southern California, Los Angeles. Dept. of Civil Engineering.

S. Lalezary, M. Pirtazari, and M. J. McGuire.
Journal of the American Water Works Association JAWWAS, Vol. 78, No. 11, p 76-82, November 1986. 11 fig. 5 tab, 12 ref.

Descriptors: *Water quality, *Activated carbon, *Taste, *Odor, *Organic compounds, *Organoleptic properties, *Water treatment, *Performance evaluation, Fate of pollutants, Carbon, Coagulation, Adsorption, Humic acids, Kinetics, Isotherms, Equilibrium.

Equilibrium studies using closed-loop stripping analysis along with experimental methodologies were conducted to evaluate the performance of were conducted to evaluate the performance of activated carbons for removing five specific tastend door-causing organic compounds that occur at the nanograms-per-liter level in water supplies. Both powdered activated carbon (GAC) proved to be more effective for removing geosmin than for removing 2-methylisoborneol (MIB). Although chlorine and coagulants had no detrimental effect on the adsorption of organics by PAC, the removal of geosmin and MIB by GAC appeared to be adversely affected by background organic compounds such as humic substances. The mixing technique used was observed to play a significant role in adsorption. (Author's abstract)

W87-04911

OZONATION: AN ECONOMIC CHOICE FOR WATER TREATMENT, Buck, Siefert and Jost, Inc., Paramus, NJ.

Bucs, Settert and Jost, inc., Paramus, NJ.
C. N. Weng, D. L. Hoven, and B. J. Schwartz.
Journal of the American Water Works Association
JAWWA5, Vol. 78, No. 11, p 83-89, November
1986. 6 fig. 10 tab, 1 ref.

Descriptors: *Water quality, *Ozonation, *Water treatment, *Cost-benefit analysis, *Economic aspects, *Performance evaluation, Taste, Odor, Organoleptic properties, Water properties, Reservoirs, Cosgulation, Filitration, Dissolved solids, Alum, Chlorine, Sludge, Sludge disposal, Pilot

A five-year pilot-plant study at the Hackensack (NJ) Water Company showed that coagulation, ozonation, and direct filtration could be used suc-(NJ) water Company showed that coagulation, onconation, and direct filtration could be used successfully to treat water from the Oradell Reservoir, producing a finished water with fewer dissolved solids and improved taste and odor. The proposed expansion of the Haworth Filtration Plant, using preozone treatment and direct filtration, will substantially reduce the use of alum, chlorine, and caustic soda. Moreover, less sludge will be produced in the treatment process, and sludge disposal will be less costly. (Author's abstract) W87-04912

DIFFERENT NEEDS BREED MANAGE-MENT'S HEED, American Water Works Service Co., Inc., Haddon Heights, NJ.

For primary bibliographic entry see Field 7A. W87-04978

IS THERE AN ANSWER TO HYDRANT TAM-PERING, Detroit Water and Sewerage Dept., MI.

Water Engineering and Management WENMD2, Vol. 133, No. 11, p 24-25, November 1986. 2 fig.

Descriptors: *Hydrants, *Hydrant tampering, *Water distribution, *Water use, *Planning, *Hydrant protection devices, Long-term planning, Product

Hydrant protection devices are needed to decrease the number of incidents involving the malicious opening of fire hydrants and the theft of hydrant parts since few water departments can afford to operate with high water loss, low water pressure sectors in the distribution network, and an increased hydrant parts replacement rate. Guidelines for assessing the extent of the problem and alternative solutions were presented. Particular emphasis was placed on the need for compatibility of special wrenches or tools required for operation of hydrants protected by different devices, for compatibility of devices with all models of hydrants in use and with those expected to be purchased, and for tight control of the specialized wrenches that open the hydrants. Specific products currently available were evaluated. (Wood-PTT)

STATIC MIXERS BRING BENEFITS TO WATER/WASTEWATER OPERATIONS, Koch Engineering Co., Inc., Wichita, KS. Static Mixing Group. For primary bibliographic entry see Field 8C. W87-04983

OUTBREAK OF GASTROENTERITIS ON A PASSENGER CRUISE SHIP, Central Public Health Lab., London (England). Communicable Disease Surveillance Centre. For primary bibliographic entry see Field 5C. W87-04987

URINARY MUTAGENS IN MUNICIPAL SEWAGE WORKERS AND WATER TREAT-

MENT WORKERS, New York State Coll. of Veterinary Medicine, Ithaca. For primary bibliographic entry see Field 5C. W87-05027

PAUL AND PETER LAKES: A LIMING EX-PERIMENT REVISITED, Notre Dame Univ., IN. Dept. of Biology. For primary bibliographic entry see Field 5G. W87-05031

PUMPING FROM MULTIPLE WELLS REDUCES WATER PRODUCTION REQUIREMENTS: RECOVERY OF MOTOR VEHICLE FUELS, LONG ISLAND, N.Y., New York State Dept. of Transportation, Hyde Park, Region 10.

1. Peterec, and C. Modesitt.

1N: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 358-373, 3 fig. 5 tab, 6 ref.

Descriptors: *Multiple wells, *Water resources development, *Gasoline, *Long Island, *New York, *Oil recovery, Hydrocarbons, Drinking water, Groundwater quality, Pump wells, Hydraulic gradient, Water quality control.

For years, Long Island has been the most intense area in the country for recovering liquid hydrocarbon from groundwater. Three million people, 2.5 million of them in Suffolk and Nassau counties, call Long Island home. The only source of drinking water for the two counties is the groundwater beneath them. In the last seven years, there have been over 100 underground releases, mostly gasolines and fuel oils, all requiring the installation and operation of recovery wells. Of these sites there are approximately 70 total recovery wells in operation. Most of the recovery wells are 26 inch diameter casings 50-70 feet deep with conventional two pump recovery systems installed. Each drawdown pump produces an average of 110 gallons/

minute. This means a total of over 11 million gallons of water is being pumped from Long Is-land's 'sole source' aquifer each day. Recently it has been demonstrated that pumping low flows from several shallow wells, in lieu of high volumes from a single deep well, can be more effective in producing a hydraulic gradient in the contaminated area of the aquifer, while reducing overall water production by as much as 60%. A new pumping system capable of pumping both oil and water together, without emulsification, makes the multiple well approach feasible. Using multiple wells allows recovery pumping to be directed to areas in the contaminant plume. This reduces the amount of previously uncontaminated subsurface exposed to the contaminant layer by more than 50%, keeping soil contamination due to dynamic recovery to a minimum. Four inch diameter PVC observation wells, which were used to identify the extent of the liquid product plume, can be used for recovery wells. This can greatly reduce installation costs as well as adding flexibility to the recovery scenario. Pump tests were conducted comparing the two methods of recovery. (See also W87-05128) (Author's abstract)

FULL SCALE GAC ADSORPTION PERFORM-ANCE COMPARED TO PILOT PLANT PRE-DICTIONS,

DICTIONS, Kennedy/Jenks Engineers, San Francisco, CA. R. S. Chrobak, D. L. Kelleher, and I. H. Suffet. IN: Petroleum Hydrocarbons and Organic Chemi-cals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Pro-ceedings of the NWWA/API Conference, Novem-ber 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 463-495, 12 fig. 8 tab, 21 ref.

Descriptors: *Groundwater pollution, *Water treatment, *Granular activated carbon, *Adsorption, Pilot plants, Trihalomethane, Phenolic compounds, Volatile organics, Pesticides, Tetrachloroethylene, Organic compounds, New Jersey.

pounds, Volatile organics, Pesticides, Tetrachloroethylene, Organic compounds, New Jersey.

Groundwater pollution by organics is a major concern of the water utility industry. Numerous instances of groundwater pollution by organics have been documented for trihalomethane precursors, phenolic compounds, volatile halogenated organics, and pesticides. Results for pilot and full scale studies conducted during the period 1979 through 1984 to investigate the performance of granular activated carbon (GAC) treatment for the removal of volatile organic compounds (VOC2), primarily ettrachloroethylene (PCE), from a contaminated groundwater supply with a low Total Organic Carbon (TOC) background are compared. The study site is located in Warren County in northwest New Jersey at the New Jersey Water Company-Washington District. The following conclusions are drawn: (1) That the unit process of assorption with GAC can effectively remove chlorinated solvents from a groundwater when the TOC is low. PCE was removed from a contaminated groundwater supply to levels less than 1 microgram/L for 34,200 bed volumes with a carbon usage rate of 102 lbs of GAC per million gallons of water treatment. 1,1,1-TCEA and 1,1-DCE were removed to the same level but not as effectively, for 12,800 and 18,200 bed volumes and carbon usage rates of 271 and 191 lbs of GAC per million gallons of water treated. (2) The pilot study was a good predictor of full scale performance in terms of breakthrough and capacity for GAC to remove the various contaminants. (3) Significant desorption of 1,1-DCE and 1,1,1-TCEA occurred due to fluctuating influent levels and competitive displacement. (4) The on-off operation of the well supply did not cause any significant operational problems with the GAC adsorption system with a low TOC water. (See also W87-05128) (Lantz-PTT) PTT) W87-05159

CARBON ADSORPTION AS AN INTERIM RE-MEDIAL MEASURE AT PRIVATE WATER WELLS

Warzyn Engineering, Inc., Madison, WI. D. W. Hall, and R. L. Mumford. IN: Petroleum Hydrocarbons and Organic Chemi-

WATER QUALITY MANAGEMENT AND PROTECTION—Field 5

Water Quality Control-Group 5G

cals in Ground Water - Prevention, Detection and cas in Ground water - Frevention, Decention and Restoration - A Conference and Exposition, Pro-ceedings of the NWWA/API Conference, Novem-ber 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 496-512, 3 fig. 4 tab, 13 ref.

Descriptors: *Gasoline, *Water treatment, *Oil spills, *Groundwater pollution, *Wellwater, Wells, Adsorption, Wausau, Wisconsin, Carbon, Volatile organics, Monitoring, Water pollution treatment, Well water.

organics, Monitoring, Water pollution treatment, Well water.

Contamination of private wells by a gasoline station near Wausau, Wisconsin, provided the opportunity to test the ability of carbon adsorption to treat the well water effectively. The gasoline contamination is an isolated problem within an area of Wausau that is the subject of a State-led ERF (Environmental Repair Fund) investigation. Longerm solutions to the gasoline problem could not be addressed. Carbon adsorption was recommended as an interim remedial measure at two private wells affected by the gasoline contamination. The following is a summary of pertinent aspects of the use of carbon adsorption as an interim remedial action at private wells, based on the case study presented and other projects: (1) Carbon is selective in the contaminants it removes, and a thorough analysis of contaminant conditions is recommended. Carbon is capable of removing volatile organics of contaminant conditions is recommended. Carbon is capable of removing volatile organics and concentration of volatile organic contaminants, tank size, water volume use, and other factors that can reduce the carbon effectiveness; (3) Some private water supplies will require other treatment to optimize carbon bed life is dependent on the type and concentration of volatile organic contaminants, tank size, water volume use, and other factors that can reduce the carbon effectiveness; (4) The dual carbon tank system provides a margin of safety, when considering potential breakthrough of contaminants in the primary tank; (5) Monitoring of treated water for a period after carbon tank installations will provide confidence in the calculated carbon tank effectiveness; (6) Local retailers of water treatment equipment generally can install and service the carbon tanks; and (7) The use of carbon as an interim remedial action may be useful in normalizing well water use, while longer term actions are evaluated and implemented. (See also W87-05128) (Lantz-PTT) PTT) W87-05160

GROUND WATER TREATMENT SYSTEM

DESIGN,
S and B Engineers, Inc., Houston, TX.
D. J. Schaezler, and J. H. St. Clair.
In: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 565-581, 2 fig, 11 tab, 4 ref.

Descriptors: *Groundwater pollution, *Water treatment, *Water pollution treatment, *Design standards, *Case studies, Cost-benefit analysis, Organic compounds, Chlorinated hydrocarbons, Trichloroethylene, Air stripping, Mathematical studies, Solvents, Biological treatment.

studies, Solvents, Biological treatment.

Two case studies illustrate the use of cost-effective treatability studies for contaminated groundwater. These studies were used to demonstrate feasibility of alternative treatment processes and to provide data for design calculations. In the first case history, groundwater was contaminated by up to 1000 ppb of chlorinated organic solvents, typified by 1,1,2-trichloroethylene. Removal of these organics of the provided by air stripping was evaluated both theoretically and experimentally. Cooling towers, stripping towers, and submerged aeration were evaluated. Theoretical approaches to stripping design were augmented by simple, bench scale stripping tests, from which Henry's Law coefficients and relative mass transfer coefficients were determined. Submerged aeration was selected for treatment because of projected satisfactory performance and the availability of an existing, unused system. This system has operated successfully for approximately 18 months. For the second case history, groundwater was contaminated by approximately 15 ppm of solvents, mainly chlorinated, and by approximately 200 ppm of isopropanol and similar com-

pounds. A treatability study was conducted to evaluate air stripping followed by biological treatment. Using theoretical approaches, augmented by experimental data, it was determined that the solvents could be removed by air stripping to below 100 ppb each, while the isopropanol was removed only slightly. However, biological treatment of isopropanol was very successful, as demonstrated in the bench scale, continuous flow unit. The treatment has been designed and should begin operations in late 1985. (See also W87-05128) (Author's abstract) W87-05164

5G. Water Quality Control

WATER TREATMENT ENTERS 'A NEW ERA'.

L. A. Rich. Chemical Week CHWKA9, Vol. 139, No. 18, p 21-

Descriptors: *Water Pollution Control Federation, *Water treatment, *Management planning, Training, Environmental Protection Agency, Wetlands conversion, Toxic wastes.

conversion, Toxic wastes.

Changes in attitudes toward water pollution control emanating for the 1986 national Water Pollution Control Federation (WPCF) conference are discussed. The 'new era' is marked by a commitment to a holistic approach to water treatment in which regulators and people in the water treatment industry view water pollution in the context of its effects on the other media: air and land. WPCF president-elect Carl V. Huber, in an interview reported here, emphasized that education, obtaining adequate numbers of qualified personnel are the new endeavors of the group. Similarly, Lawrence J. Jensen, Environmental Protection Agency assistant administrator for water stated the EPA itself is beginning to look seriously at such problems as agricultural conversion of wetlands and toxic chemicals in the environment as part of a view of environmental regulation that extends beyond the 'pipe and tap' preoccupation that has dominated the past 15 yr. (Rochester-PTT)

GIVE HEALTH A CHANCE - WITH HEALTHY SURROUNDING

Johns Hopkins Univ., Baltimore, MD.

World Health Forum WHFODN, Vol. 7, No. 2, p

107-113, 1986

Descriptors: *Water resources development, *Sanitation, *Developing countries, *Water treatment facilities, *Public health, Urbanization, Financing, Local initiatives, Rural areas.

nancing, Local initiatives, Rural areas.

The problems of achieving safe water and sanitation and other aspects of a healthy human environment for the world's people are addressed. The author argues that lasting improvements in health can be won only if living conditions are satisfactory. Governments should not neglect environmental requirements simply because of the emergence of spectacularly successful therapies and even preventive measures, which in themselves do not offer a permanent answer to the threat of disease and accidents. In making efforts to upgrade public health, some points to be kept in mind are of the world's 30 largest conurbations, 21 are in the developing countries, where the task of providing water supplies and sanitation is particularly difficult; rapid population growth in all developing countries outpaces the rate at which water supplies are installed; and a high percentage of rural populations remain in developing countries long after the year 2000. Greater emphasis should be placed on using local money, local institutional structures, and most important of all, local people. (Rochester-PTT) ter-PTT) W87-04380

PRICE GROUNDWATER JOB STAYS ON

J. J. Kosowatz, and L. Gross. Engineering News - Record ENREAU, Vol. 217,

No. 14, 43-44, October 2, 1986.

Descriptors: *Legal aspects, *Water quality man-agement, *Public policy, *Toxicity, *Water quality control, *Water analysis, *Water pollution, *Groundwater pollution, Administrative agencies, Water pollution control, Legislation, Waste dispos-al, Wastewater treatment, New Jersey.

al, Wastewater treatment, New Jersey.

Federal money and manpower are being concentrated on groundwater protection from abandoned toxic waste dumps and existing hazardous chemical sites. However, performing the job has not been easy; nationwide, only 13 sites have been completely cleaned up since Superfund began with a 31.6 billion fund in 1980. Work is also impeded by the difficulty of obtaining liability insurance. (2) The Ciba-Geigy Corporation's Toms River plant in New Jersey has developed into one of the most volatile and complex environmental problems in the state. About 1.5 billion gallons of groundwater in a plume covering 375 acres has been contaminated with numerous volatile organic chemicals. The treatment process for cleanup is described. (3) The Atlantic City (New Jersey) water supply is in danger of contamination from a nearby closed landfill, ranked third in priority on the state's list of hazardous waste sites. The Environmental Protection Agency is expected to define accepted remedial action costing \$10 million to clean up a mileong plume of groundwater contaminated with high levels of volatile organic chemicals. (Doria-PTT) W87-04479

RESPONSES OF THE LOBELIA-EPIPHYTE COMPLEX TO LIMING OF AN ACIDIFIED

LAKE, Lund Univ. (Sweden). Dept. of Ecology.

Luna Univ. (sweden). Dept. of Ecology. S. Lazarek. Aquatic Botany AQBODS, Vol. 25, No. 1, p 73-81, August 1986. 1 fig, 3 tab, 27 ref.

Descriptors: "Water pollution effects, "Isotope studies, "Bioaccumulation, "Tissue analysis, "Epiphytes, "Water pollution treatment, "Liming, "Acidified lake, "Sweden, Chlorophyll, Liquid scintillation, Radiolabelling, Carbon dioxide, Biomass. Phytoploankton, Species cor

The rates of radiocarbon uptake and chlorophyll content of the Lobelia epiphyte complex were studied in the acidified lake, Gardajon, Sweden. Before liming and one and three years after liming estimates were made for Lobelia dortmanna L. leaves with epiphyton and for leaves without epiphyton. Solitary rosettes of L. dortmanna were sampled and rigid leaves in the third whorl from the apex were quantitatively analyzed. The chlorophyll a content of the leaf-epiphyte system was determined for leaf segments with attached epiphyton and for segments from which epiphytes where the state of t phyll a content of the leaf-epiphyte system was determined for leaf segments with attached epiphyton and for segments from which epiphytes were removed. Leaf segments were homogenized and extracted in methanol. Plants were incubated individually in 1-L plexiglas chambers that were placed over the plants and inserted in the sediment. One ml containing 4 microCi of NaH(14C)O3 was injected into each chamber. Fixed samples from 1981 and 1982 were counted after digestion. Samples from 1984 were combusted in an oxidizer. Radioactivity was counted in a liquid scintillation counter. Concentration of CO2 in the water at the incubation depth was determined in an IR carbon analyzer. Photosynthetically available radiation was measured with a quantum meter. Chlorophyll content of leaf segments without epiphyton was lowest in acidic conditions and highest in the third year after liming. Epiphytic 14CO2-uptake was significantly higher in acidic conditions and was positively correlated with the chlorophyll content of corresponding segments of leaves with epiphyton. Liming induced changes in the species composition and biomass of the phytoplankton and reduced epiphytic cover. (Main-PTT)

OPTIONS FOR FINANCING ACID RAIN CON-

TROLS, Georgia Univ., Athens. Inst. of Natural Resources. For primary bibliographic entry see Field 6C. W87-04568

Group 5G—Water Quality Control

GROUT AND SLURRY WALLS FOR HAZ-WASTE CONTAINMENT: THE DOWN SIDE, California Univ., Berkeley. Dept. of Mechanical G. J. Trezek

Hazardous Waste and Hazardous Materials, Vol. 3. No. 3, p 281-292, 1986. 5 fig, 8 ref.

Descriptors: *Water pollution effects, *Waste storage, *Wastewater treatment, *Chemical wastes, *Containment structures, *Groundwater, *Leachates, *Grout curtains, *Slurry walls, Wastes, Porosity, Permeability, Grouting.

The results of engineering case studies at two Superfund site demonstrated the inability to contain hazardous wastes with grout curtains and alurry walls. The nature of the chemical wastes attacked and changed the porosity and properties of these engineered containment structures. For example, it was shown that the permeability of a bentonite slurry could be increased by several orders of magnitude in the presence of chemical waste leachate. These structures were also difficult to key or seal to bedrock which itself may be inherently fractured or become fractured during inherently fractured or become fractured during inherenty fractured or become fractured during the keying process. Thus, grout curtain and slurry wall containment structures should only be viewed as a temporary means of reducing the influx of groundwater into the wastes and not as long term gaountwater into the wastes and not as long term permanent remedies in lieu of detoxification, con-version or destruction of the wastes. (Author's abstract) W87-04582

COMPARISON OF THREE RISK ASSESSMENT TECHNIQUES FOR EVALUATING A HAZARDOUS WASTE LANDFILL, Washington State Univ., Pullman.
For primary bibliographic entry see Field 5E.
W87-04583

NEGOTIATION AND MEDIATION: THE NEWEST APPROACH TO HAZARDOUS WASTE FACILITY SITING,

Boston College Environmental Affairs Law Review BCERDX, Vol. 13, No. 3, p 329-378,

Descriptors: *Waste facilities, *Waster law, *Waste disposal, *Hazardovs materials disposal, *Hazardous materials, *Negotiations *Mediation, *Legal aspects, Wastes, Statutes.

The role of mediation and negotiation in sitting of hazardous waste facilities was discussed. The political and legal framework regulating hazardous waste facility siting decisions was introduced and the conclusion that the major obstacle to the facilities. ty siting is public opinion was presented. Siting decisions are particularly influenced by public opposition because they are made at the state and not the federal level of government. State facility e and not the federal level of government. State facility siting techniques that provide no role for negotiation or arbitration and those that do allow for it, specifically the Massachusetts Hazardous Waste Facility Siting Act, were discussed. The Massachusetts statute was compared with those enacted in Rhode Island, Wisconsin and Connecticut, and theoretical advantages and disadvantages were described. (Wood-PTT)

COUNTERING ENVIRONMENTAL CRIMES, Department of Justice, Washington, DC. Environ-mental Crimes Unit. For primary bibliographic entry see Field 6E. W87-04659

CONTAMINANTS IN DRINKING WATER AND CANCER RISKS IN CANADIAN CITIES, Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch. Por primary bibliographic entry see Field 5C. W87-04671

GARDSJON PROJECT: LAKE ACIDIFICA-TION, CHEMISTRY IN CATCHMENT

RUNOFF, LAKE LIMING AND MICRO-CATCHMENT MANIPULATIONS, Swedish Environmental Research Inst., Goete-For primary bibliographic entry see Field 5C. borg.

LABORATORY EVALUATION OF GAMBUSIA AFFINIS FISH AS PREDATORS OF THE SCHISTOSOME-BEARING SNAILS BULINUS TRUNCATUS,
American Univ., Beirut (Lebanon). Dept. of Environmental Health. For primary bibliographic entry see Field 2H. W87-04743

DESIGNING HYDRO RESERVOIRS TO PRE-VENT TROPICAL DISEASES, Blue Nile Associates, Foxboro, MA. For primary bibliographic entry see Field 8A. W87-04773

PROCESS FOR RESTORING NITRATE CON-TAMINATED GROUND WATERS BY MEANS OF HETEROTROPHIC DENITRIFICATION IN AN ACTIVATED CARBON FILTER AND AER-OBIC POST-TREATMENT UNDERGROUND, Valce LV. By Leade Dunto. Karlsruhe Univ. (Germany, F.R.). Engler-Bunte

R. Bockle, U. Rohmann, and A. Wertz. Aqua AQUAAA, No. 5, p 286-287, 1986. 1 fig, 1 tab, 3 ref.

Descriptors: *Water pollution treatment, *Filtra-tion, *Activated carbon, *Nitrates, *Heterotrophic bacteria, *Denitrification, *Water treatment, *Cost analysis, Dissolved solids, Organic matter, Soil aeration. Aeration zone

Procedures for denitrification in an activated Procedures for denitrification in an activated carbon filter and some of the results for trial of this technique are reported. Nitrate removal in this system is effected by microrganisms able to denitrify heterotrophically. With nitrate in the raw water at 60 mg/l, the treatment yielded a concentation of 5 mg/l nitrate in the effluent from the filter and 5 mg/l after 10 m of underground pasage of the oxygen-enriched filter effluent through the aerobic zone. For the raw water, dissolved organic carbon was 1.5 mg/l; after denitrification it was 1.7 mg/l; and after passage of the aerated organic caroon was 1.5 mg/; after denturnication it was 1.7 mg/; and after passage of the aerated water through the ground it was 0.9 mg/l. A tentative calculation of the costs for a full-scale plant aiming to reduce nitrate content from 55-60 mg/l to 25 mg/l suggests an increase in water cost to the consumer of no more than 0.30 Deutschmarka/cu m. (Rochester-PTT) W87-04794

LEGISLATIVE AND TECHNICAL MEANS FOR THE PREVENTION OF ACCIDENTS WITH WATER-ENDANGERING LIQUIDS, Environmental Protection Authority Grisons, Chur (Switzerland).

Aqua AQUAAA, No. 5, p 293-300, 1986. 8 fig.

Descriptors: *Water pollution sources, *Water pollution prevention, *Oil industry, *Saftey, *Accidents, Pipelines, Switzerland, Statistics.

The Swiss water protection regulations referring to water-endangering liquids and their implementation are discussed. Three examples from the Canton of Grisons are described to illustrate the practical application of existing regulations. These are: the major tankfarm of the Association of Agricultural Cooperatives of Eastern Switzerland (fuel oil and combustibles), the Central European Oil Pipeline, and the Oldis underground reservoir (light fuel oil in eight unlined cavities in rock). Federal damage statistics show that the safety of facilities and the protection of water against pollution is well covered, at least by rules and regulations. The desired protection will only be realized with quality-conscious production of the required facilities and safety-conscious behavior of the operators. (Rochester-PTT)

INFORMATION NEEDS FOR GROUNDWAT-ER POLLUTION CONTROL, Case Western Reserve Univ., Cleveland, OH. For primary bibliographic entry see Field 4B. W87-04811

PREPARATION OF PROFESSIONALS FOR GROUNDWATER PROTECTION, California Univ., Los Angeles. For primary bibliographic entry see Field 9A. W87-04812

LOCAL FINANCE AND POLICY FOR GROUNDWATER PROTECTION, Cornell Univ., Ithaca, NY.
For primary bibliographic entry see Field 9D.
W87-04813

FUNCTIONS AND ACTIVITIES OF GROUND-WATER PROTECTION: IMPLICATIONS FOR INSTITUTIONAL COORDINATION, Oklahoma Univ., Norman. Environmental and Ground Water Inst. For primary bibliographic entry see Field 6E. W87-04814

CONCEPTUAL DESIGN FOR A GROUND-WATER QUALITY MONITORING STRATEGY, Iowa Univ., Iowa City.
For primary bibliographic entry see Field 7A.
W87-04817

SAFE DRINKING WATER LAW TOUGHENED, Environmental and Energy Study Inst., Washington, DC. For primary bibliographic entry see Field 6E. W87-04823

RESTORATION OF TWO LOWLAND LAKES BY ISOLATION FROM NUTRIENT-RICH WATER SOURCES WITH AND WITHOUT RE-

MOVAL OF SEDIMENT, University of East Anglia, Norwich (England). School of Environmental Sciences. B. Moss, H. Balls, K. Irvine, and J. Standfield. Journal of Applied Ecology JAPEAI, Vol. 23, No. 2, p 391-414, August 1986. 13 fig, 2 tab, 34 ref.

Descriptors: *Water pollution effects, *Water pollution treatment, *Sediment control, *Stream Diversion, *Clake restoration, *Eutrophic lakes, *Lake sediments, *Nutrient removal, *Phytoplankton, Isolation, Nitrogen fixation, Plant populations, Plant growth, Turbidity, Phosphorus, Aquatic plants, Lakes.

The Norfolk Broadland comprises about 50 small shallow lakes and has suffered extreme eutrophication. Restoration of the once clear water and aquatic plant communities from the present phytoplankton dominance was attempted in two experiments. First, the Alderfen Broad was isolated by diversion of an inflow stream without removal of its recently deposited phosphorus-rich sediments. In the second experiment, sediment was removed from Cockshoot Broad and dams were placed against the effluent-rich River Bure, but the Broad continued to be fed by a small stream draining an agricultural and fen catchment. In four years (1979-1982) after isolation of Alderfen Broad, the hyttoplankton crop was greatly reduced and the (1979-1982) after isolation of Alderfen Broad, the hystoplankton crop was greatly reduced and the water cleared. Net release of PO4-P from the sediment ceased and the Broad became dominated by Certaphyllum demersum L. Because of reduction of water column turbulence caused by plants and the organic matter supplied to the sediment surface in their decay, the mechanism for release of PO4-P from the sediment was reactivated and, in 1984 supported a large phytoplankton crop in the 1984, supported a large phytoplankton crop in the spring. The aquatic plant popluation declined. In 1985 there was both spring and summer phytoplankton growth, the latter probably supported by nitrogen fixation, and aquatic plant growth was negligible. In Cockshoot Broad, a reduction in the latter probably supported by the control of phytoplankton growth occurred soon after isola-tion and sediment removal, and the water cleared. Part of the Broad has already recolonized with a W87-04854

diverse collection of aquatic plants. The consequences of these results for the management of the rest of the Broad are discussed. (Author's abstract)

INFLUENCE OF SOME PHYSICO-CHEMICAL FACTORS ON CADMIUM UPTAKE BY THE GREEN ALGA STICHOCOCCUS BACILLARIS, Polish Academy of Sciences, Zabrze. Inst. of Environmental Engineering.

T. Skowronski.

Applied Microbiology and Biotechnology, Vol. 24, No. 5, 423-425, August 1986. 4 fig, 10 ref. Polish Academy of Sciences Project No. 10.2.

Descriptors: *Bioaccumulation, *Water pollution effects, *Path of pollutants, *Algae, *Cadmium, *Adsorption, *Fate of pollutants, Hydrogen ion concentration, Ions, Transport, Nutrients, Temperature, Heavy metals.

The influence of factors such as pH, temperature, light, the presence of other ions and chelating agents, water hardness and nutrient levels on cadmium uptake by the microagla Stichococcus bacillaris was studied. It was shown that S. bacillaris was studied. It was shown that S. bacillaris takes up cadmium by adsorption and energy-dependent transport. A distinct manganese influence on the time course of cadmium uptake suggests that both elements are taken up by S. bacillaris by means of a common transport system. Curves were obtained from measuring cadmium content of alga cells after five minutes and four hours of incubation. Cd(2+) decreased with the decrease in pH until it was close to zero at pH 4. After five hours of incubation, some increase in cadmium content in until it was close to zero at pH 4. After five hours of incubation, some increase in cadmium content in biomass is achieved compared with that after five minutes, but the increase is not the same at different values of pH. At low pH, cadmium transport is probably blocked because of membrane potential decrease. There may be a blocking of transport in acid medium or there may be formation of cadmium complexes or cadmium precipitation above pH 7.5. (Michael-PTT)
W87-04848

NITRATES IN GROUND AND DRINKING WATER: ANALYSIS OF POLICIES AND REG-

ULATIONS, International Inst. for Environment and Society, Berlin (Germany, F.R.).

J. Conrad. The Science of the Total Environment STENDL, Vol. 51, p 209-225, May 1986. 6 fig, 3 tab, 18 ref.

Descriptors: *Water pollution sources, *Nitrates, *Groundwater, *Drinking water, *Regulations, *Policy making, *Decision making, Risks, Public policy, Political constraints, Agricultural chemicals.

cals.

The process of risk management and political decision-making does not follow the normative ideal of a scientifically based risk assessment and subsequent decision-taking. This article offers some preliminary results of a larger research project investigating the risk management process with respect to the environmental and health hazards of mitrates in ground and drinking water in several countries. Some general theorems are developed in research on risk assessment with the help of the nitrate example. The research project is described and some of the main lessons to be learned from risk assement research are summarized. The physical structure of the nitrate problem is outlined, the general features of the politics governing the nitrate burden on ground and drinking water are described and a rough classification of different national strategies towards the nitrate problem is presented. A specific example of a state policy to cope with increasing nitrate levels is provided. Conclusions regarding risk management include: established socio-economic structures and distribution of political power determine, to a large extent, the political power determine, to a large stent with agricultural chemicals than with industrial with agricultural chemicals than with industrial with agricultural chemicals than with industrial tional regulatory transcription of the nitrate prob-lem; and, risk assessment is significantly differnt with agricultural chemicals than with industrial chemicals because of differences in institutional structures and the role of spatial arrangements in agriculture. (Michael-PTT)

TREE THAT PURIFIES WATER. CULTIVATING MULTIPURPOSE MORINGACEAE IN

THE SUDAN,
Deutsche Gesellschaft fuer Technische Zusanmenarbeit G.m.b.H., Eschborn (Germany, F.R.).
Section for Water Supply and Sanitation.
S. Jahn, A. Musnad, and H. Burgstaller.
Unasylva, Vol. 38, No. 152, p 23-28, 1986. 9 ref.

Descriptors: *Moringaceae, *Water treatment, *Bi-ological water treatment, *Trees, *Nile River, *Cultivation, Seed treatment, Seedlings, Sudan,

Germination.

Different methods of cultivation appropriate to different species of the moringaceae tree are examined. Seeds of this tree posess flocculating properties and are used to treat and clarify turbid water from the Nile River in the Sudan. The objective of cultivation trials was to determine which Moringa species could provide the essential raw material for purification in the shortest time and with maximum yield. Seed propagation was used and sowing was tested during the cool dry season, the hot dry season and the rainy season. Pretreatment of seeds from Moringa oleifera and Moringa stenopetala was of no advantage at any time of the year. Cooling to 8 C caused slight delays in germination onset and a minor reduction in germination frequency as compared to untreated seeds. The optimum light condition for germination of all species was half shade. Seedlings appearing first in a batch usually exhibited the fastest development, but seedlings of Moringa drouhardii, which had the longest dormancy period, grew faster than those of the other two species. Satisfactory growth of transplanted seedlings depended mainly on suitable spacing and adequate water. Flowering of Moringa oleifera occurred after 10 to 11 months and ripe dry seeds were available two months later. Moringa stenopetala trees required a longer time. This experience in the seed cultivation of Moringa oleifers occurred after 10 to 10 months and ripe try seeds were available two months later. Moringa of moring of moring of moring of of moring of of moring o inga stenopetala trees required a longer time. This experience in the seed cultivation of Moringa oleiexperience in the seed cuntivation of morning ober-fera and Moringa stenopetala can be used as guid-ance for plantations in similar environments where longer roots are an advantage for stabilization and access to water. (Author's abstract) W87-04887

LONG-RANGE AIR POLLUTION: A THREAT TO EUROPEAN FORESTS, P. Bazire, G. Calabri, M. Mariani, and T. V. Nao. Unasylva, Vol. 37, No. 149, p 14-25, 1985. 2 tab.

Descriptors: *Interagency cooperations, *Governmental interrelations, *Air pollution effects, *Forests, *Europe, *Monitoring, *Regional planning, Soil conservation, Hydrologic budget, Pollution load, Recreation, Research priorities.

Damage to the growth and even existence of the European forests from long range air pollution undermines not only their productive capacity, but also other critical functions including soil conservation, regulation of water balances, genetic resource conservation, recreation and the improvement of the quality of life. Forests also constitute a key element in the lifestyles of many Europeans. Prevention, monitoring and control measures have been adopted at the national level, but they are not always adequate or sufficient, nor are they always coordinated with neighboring countries adopting similar measures. Cooperation at the subregional level, European level or the interregional level can similar measures. Cooperation at the subregional level, European level or the interregional level can strengthen the impact of national programs on both basic and applied research and on the implementation of operations. Countries should consider strengthening their actions on collection of data on the magnitude and extent of degradation, research programs and prevention policies. On the international level, rapid exchange of information on pollution causes and effects and coordination of prevention and control measures are required to challenge the air pollution threat to European forests. (Michael-PTT) W87-04891 W87-04891

EVALUATING RELATIVE STRINGENCIES OF EXISTING AND PROPOSED MICROBIOLO-GICAL MCLS,

Water Quality Control—Group 5G For primary bibliographic entry see Field 5F. W87-04907

EVALUATING ACTIVATED CARBONS FOR REMOVING LOW CONCENTRATIONS OF TASTE- AND ODOR-PRODUCING ORGANICS, University of Southern California, Los Angeles. Dept. of Civil Engineering. For primary bibliographic entry see Field 5F. W87-04911

OZONATION: AN ECONOMIC CHOICE FOR WATER TREATMENT, Buck, Siefert and Jost, Inc., Paramus, NJ. For primary bibliographic entry see Field 5F. W87-04912

RUNOFF AND EROSIVE STORM OCCUR-RENCE PROBABILITIES, Rhode Island Univ., Kingston. Dept. of Natural

Resources Science.

A. J. Gold, T. L. Loudon, and F. V. Nurnberger.

Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 119-123, January-February 1986. 2 fig, 7 tab, 17 ref.

Descriptors: *Agricultural runoff, *Soil erosion, *Runoff, *Erosion, *Storms, *Rainfall intensity, *Weather data collections, *Storm probability, Probability distribution, Hydrology, Rainfall, Overland flow, Agricultural lands, Michigan, Numerical analysis, Evapotranspiration

Since the passage of the Federal Water Pollution Control Amendments of 1972 (PL 92-500), national efforts to curtail waterborne pollutants from agricultural lands have been steadily increasing. In the Great Lakes drainage basin, fine textured agricultural soils planted to row crops have been identified as the major nonpoint source of sediment and phosphorus per unit area. Long-term records of storm magnitude and intensity were used to generate monthly occurrence probabilities of hydrologic events on agricultural lands in mid-Michigan. Based on the SCS curve number method, appropriate combinations of storm magnitude and 5 day antecedent rainfall from 53 years of records were employed to predict the occurrence of overland anteceuent raintall from 53 years of records were employed to predict the occurrence of overland flow events. Records of excessive rate storms and antecedent rainfall were used to determine the occurrence probability of potentially erosive overland flow events. (Alexander-PTT) W87-04922

MANAGING FEEDLOT RUNOFF WITH A SET-TLING BASIN PLUS TILED INFILTRATION

ce and Education Administration, Coshocton, W. M. Edwards, L. B. Owens, R. K. White, and

W. M. Edwards, L. B. Owens, R. A. Write, and N. R. Fausey. Transactions of the ASAE TAAEAJ, Vol. 29, No. 1, p 243-247, January-February 1986. 3 fig, 3 tab, 16 ref.

Descriptors: *Water pollution prevention, *Path of pollutants, *Feedlot runoff, *Settling basins, *Infiltration beds, *Runoff, *Animal wastes, Storms, Cattle, Dikes, Transport, Nutrients, Chemical oxygen demand, Phosphorus, Potassium, Nitrogen.

Previous work indicated that a settling basin and Previous work indicated that a settling basin and sodded filter strips reduced overland solids transport by 90%; however, under wet antecedent conditions, even the longest filter strip proved inadequate. The effectiveness of the filter strips depended upon how much of the feedlot runoff infirated 'en route' and was therefore not measured at the waterway outlet. Subsurface quality and quantity were not measured. Each year for 3 years, 56 beef steers were fed to market weight in a paved feedlot in east-central Ohio. Runoff from the lot, which was scraped weekly, was measured and feedlot in east-central Ohio. Runoff from the lot, which was scraped weekly, was measured and sampled during each storm to define concentration and transport of TS, COD, N, P, and K. The runoff was allowed to pass through a shallow, concrete settling basin into a sodded, tiled infiltration bed which was diked to prevent surface discharge to the receiving stream. Samples of effluent

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from the settling basin and discharge from the tile lines were analyzed to determine reductions in concentration and transport of the measured parameters. The settling basin reduced transport by the 40% and concentrations at the tile outlets ranged between 5 and 40% of those measured at the feedlot. The tiled infiltration bed reduced nutrient transport more than did a 33 m long grassed filter strip, but was less effective than a 66 m filter strip. During the 3-year study period, Reed Canarygrass threved in the infiltration bed and there was no surface discharge to the receiving stream. (Alexander-PTT) der-PTT)

RESTRICTIVE SPECIFICATIONS, For primary bibliographic entry see Field 6E. W87-04979

MANAGING INDIA'S ENVIRONMENT, For primary bibliographic entry see Field 6E. W87-04995

WORLD BANK SERIES ON INTEGRATED RE-SOURCE RECOVERY,
Commission of the European Communities, Brussels (Belgium). Concertation Unit for Biotechnol-

ogy. For primary bibliographic entry see Field 5E. W87-04997

EICHHORNIA CRASSIPES (MART) SOLMS IN RELATION TO PH, Regional Research Lab., Hyderabad (India). Bio-

control Unit.

For primary bibliographic entry see Field 5C. W87-05001

PAUL AND PETER LAKES: A LIMING EX-

PERLIMENT REVISITED,
Notre Dume Univ., IN. Dept. of Biology.
M. Bleser, J. J. Elser, and S. R. Carpenter.
The American Midland Naturalist AMNAAF,
Vol. 116, No. 2, p 282-285, October 1986. 8 fig., 5
tab., 38 ref. NSF Grant BSR 83 08918.

Descriptors: *Liming, *Acid lakes, *Neutraliza-tion, *Water pollution effects, *Limnology, Lakes, History, Monitoring, Alkalinity, Algae, Zooplank-ton, Species composition, Population dynamics,

From 1951-1976, Peter Lake was limed periodically while neighboring Paul Lake was used as a reference ecosystem. The persistence and variabilireference ecosystem. The persistence and variability of the response of Peter Lake to liming was investigated by collecting all available historical data on the lakes and by monitoring the limnological properties of both lakes weekly from June-August, 1984. Physical and chemical changes in limed Peter Lake included increases in pH, alkalinity, dissolved inorganic carbon (DIC) concentration transparence. ity, dissolved morganic carron (DIC) concentra-tion, transparency, oxygen content and summer heat content. These changes occurred rapidly in 1951 and have persisted with little variability until 1984. Several differences in algal and zooplankton community composition and dynamics were asso-ciated with the physical and chemical changes. Historical data and observations indicate that the planktonic community structure of Peter Lake has been more variable than that of unlimed Paul Lake. (Author's abstract)

DEVELOPMENT AND IMPLEMENTATION OF REGULATIONS TO CONTROL UNDER-GROUND FUEL STORAGE TANKS ON CAPE

COD, IEP, Inc., Barnstable, MA. For primary bibliographic entry see Field 5G. W87-05072

DEVELOPMENT AND IMPLEMENTATION OF REGULATIONS TO CONTROL UNDER-GROUND FUEL STORAGE TANKS ON CAPE

IEP, Inc., Barnstable, MA.
S. W. Horsley, and D. S. Blackmar.
IN: Innovative Means of Dealing with Potential
Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 29-39, 4 tab, 1 append.

Descriptors: *Administrative regulations, *Water quality control, *Cape Cod, *Massachusetts, *Storage tanks, *Underground storage, Groundwater pollution, Groundwater quality, Water pollution prevention, Water pollution control, Fuel, Oil spills, Aquifers, Regulations.

The sole source of drinking water for Cape Cod, is a glacial aquifer largely comprised of sand and gravel outwash. Approximately 130 public supply wells and some 15,000 private on-lot wells furnish nearly nine billion gallons of water per year to the residents of the fifteen Cape Cod towns. The probresidents of the fifteen Cape Cod towns. The problem of leaking underground storage tanks was identified as a major threat to groundwater in the 1978 Water Quality Management Plan/EIS for Cape Cod, published by the Cape Cod Planning and Economic Development Commission. At about the same time, a gasoline spill from a ruptured underground storage tank at a service station in the Town of Truro was discovered. After croundwater investigations were completed, a in the Town of Truro was discovered. After groundwater investigations were completed, a plume of gasoline-contaminated groundwater was determined to be migrating toward a nearby public water supply well field. Since 1979, all fifteen Cape Cod towns have adopted either general by-laws or health regulations to control underground fuel storage tanks. In either case, the town board of health is the administrative authority which carries out the regulations in conjunction with the fire department which also has some regulatory authority over underground fuel storage. The major provisions include: (1) Registration; (2) Inventory control; (3) Leak testing; and (4) Specifications for new installations. Findings reported with the periodic testing stress the importance of: (1) Faced with poor methods and the subjectivity that exists with interpreting daily inventory records, periodic with poor methods and the subjectivity that exists with interpreting daily inventory records, periodic testing is simple to implement; (2) Periodic testing requirement when enforced, creates an incentive for tank owners to voluntarily replace inferior tanks and invest in new, longer term reliable tank facilities; and (3) Technologies used in performing periodic tank tightness tests are the only method available to perform a spot test with near absolute certainty. (See also W87-05071) (Lantz-PTT) W87-05072

ELECTRICAL LEAK DETECTION SYSTEMS FOR UNDERGROUND STORED CHEMICALS

AND FUELS, Residuals Mar agement Technology, Inc., Madison, WI. R. J. Rob

Robbins, and D. G. Nichols. IN: Innovative Means of Dealing with Potential Sources of Ground Water Contamination. Pro-ceedings of the Seventh National Ground Water Cecuings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 40-44, 4 ref.

Descriptors: *Electrical equipment, *Leak detectors, *Underground storage, *Chemicals, *Fuel, *Water quality control, *Groundwater pollution, *Monitoring, Water pollution control, Water pollution prevention, Leakage, Electrical properties, Conductivity, Water sampling.

Recent US Senate testimony indicates that be-tween 75,000 to 100,000 underground storage tanks are leaking across the country. Growing nation-wide interest is aimed at managing the "L.U.S.T." or Leaking Underground Storage Tank problem. The physical environment and chemical character-istics of stored materials must be evaluated so that istics of stored materiais must be evaluated so that suitable leak detection and prevention methods and equipment can be designed, selected and installed. Leak detection systems can be applied to situations where chemicals or fuels are stored either above or underground. Several types of leak detection sys-tems currently are available. They can be divided

into three groups: (i) The manually assisted electrical leak detection systems, which are usually light weight, portable, self-contained units that provide accurate measurements of the presence of, depth to, and thickness of lighter than water immiscible liquids, such as gasoline, petroleum, etc. These units are usually powered by self-contained, low voltage DC batteries, and may be used within observation wells as small as 2 inches in diameter; (2) The permanent in-situ probe or cable which monitors the presence of specific products. Various monitoring techniques are used such as: electrical capacitance, electrical conductivity, electrical conductivity/pressure, temperature, ionic concentration, conductivity and refractivity, thermal conductivity. These units monitor immiscibles, either lighter or heavier than water, or miscibles; and (3) The sample drawing analyzer, which is commonly used to measure changes in the Total Organic Carbon (TOC) content in the groundwater sample. This type of unit is located in the proximity of the tanks, and draws groundwater samples, automatically tests them for TOC, and records the test analysis result. (See also W87-05071) (Lantz-PTT) W87-05073

MANAGEMENT OF GASOLINE LEAKS - A

MANAGEMENT OF GASOLINE LEARS - A
POSITIVE OUTLOOK,
Los Angeles City Dept. of Water and Power, CA.
M. L. Blevins, and D. E. Williams.
IN: Innovative Means of Dealing with Potential
Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio,

Descriptors: *Gasoline, *Leakage, *Storage tanks, *Water pollution control, *Groundwater pollution prevention, Water pollution control, Water pollution treatment, Containment systems. s, Biodegradation, Fuel.

Gasoline containment and transmission facilities constructed in close proximity to fresh groundwater reservoirs pose increasing risks of contamination by leakage from these facilities. Regulatory agencies have recognized this problem and several promising monitoring and control programs are presently being developed. In the past 15 years, a sufficient amount of data has been collected to propose an effective method to restore the gasoline contaminated aquifer to near its original quality. This method involves three distinct phases: (1) detection and containment; (2) free gasoline recovery; and (3) bacterial degradation. It is important that early discovery and containment of any suspected leak be made as soon as possible so that recovery procedures may be started and the area pected leak be made as soon as possible so that recovery procedures may be started and the area of gasoline removal minimized. The first phase of the clean-up process involves removal of free gasoline to the point where no more drains by gravity resulting in only pellicular gasoline adhering as films to the surfaces of the porous media. Once recovery of all free gasoline is complete, aeration of the contaminated zone is accomplished, (when of the contaminated zone is accomplished, (when geohydrologic conditions permit) by lowering the water table below the zone of suspected contamination. This aeration promoted rapid bacteriological degradation of the remaining pellicular gasoline se several bacterial species (Pseudomonas and Arrhrobacter) which utilize gasoline as a source of energy. Results from a major gasoline leak in the Forest Lawn area of Glendale, California in 1968 supports the effectiveness of this technique. Examples on the use of this clean-up procedure area applied to several current gasoline leaks in the Southern California area. (See also W87-05071) (Author's abstract)

EPICHLOROHYDRIN IN SECONDARY CON-

EPICHLOROHYDRIN IN SECONDARY CONTAINMENT SYSTEMS,
Carlisle SynTec Systems, PA.
W. E. Witherow.
IN: Innovative Means of Dealing with Potential
Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water
Quality Symposium, September 26-28, 1984, Las
Vegas, Nevada. National Water Well Association,

Water Quality Control—Group 5G

500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 84-94, 8 fig, 19 ref.

Descriptors: *Water pollution control, *Containment systems, *Epichlorohydrin, *Materials testing, *Groundwater pollution, Leakage, Storage tanks, Underground storage, Water quality control, Oil spills, Water pollution prevention, Ft Lauderdale, Florida, Temperature, Strength, Permediale, *Florida, Temperature, Strength, Permediale, *

derdale, Florida, Temperature, Strength, Permeability.

Defined here is the problem of leaking underground fuel tanks, and the real and potential threats to groundwater in the U.S., as well as legislation describing how the EPA will regulate fuel tanks, and the legal and liability ramifications of Federal or State legislations and their effect on tank owners. Leak detection and spill containment, and collection system options such as secondary containment systems are included as possible solutions to this serious and emerging problem. Specifically investigated are a wide spectrum of physical properties, especially aromatic hydrocarbon resistance for an unsupported epichlorohydrin lining that is being used today in several secondary containment systems in the United States. Laboratory testing was performed in accordance with latest American Society of Testing and Materials (ASTM) standard test methods. Some of the more important physical properties are tensile strength, elongation, modulus, % swell (by volume) and water vapor permeability. Short- and long-term immersion studies were conducted in crude oil, diesel fuel No.2 and a brine water/oil mixture at room and elevated temperatures. Comparative studies were performed to evaluate other materials such as thermoplastic chlorinated polyethylene (CPE) and Hypalon and polychloroprene or neoprene (CR) rubber in ASTM oil No.3, ASTM fuel C and American and European gasohol at room and elevated temperatures. A case history about the first epichlorohydrin secondary containment system in Ft. Lauderdale, Florida showing typical installation and advantages such as cost effectiveness, watertightness, low permeability and flexible are presented. (See also W87-05071) (Lantz-PTT) W87-05075

PRACTICAL DISPOSAL WELL DESIGN FOR THE PREVENTION OF GROUND WATER CONTAMINATION,

CONTAMINATION,
Davis (Ken E.) Associates, Houston, TX.
K. E. Davis, and M. Jarrell.
IN: Innovative Means of Dealing with Potential
Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water
Quality Symposium, September 26-28, 1984, Las
Vegas, Nevada. National Water Well Association,
500 W. Wilson Bridge Road, Worthington, Ohio,
1984. p 111-140, 11 fig, 21 ref.

Descriptors: *Disposal wells, *Groundwater pollution, *Water pollution prevention, *Design standards, Cements, Temperature, Structural engineering, Hydraulic pressure, Hydrodynamics, Electrical equipment, Monitoring, Case studies, Water quality control, Water pollution control, Ground-

water quality.

The design of a disposal well system requires the consideration of many factors; however, none are as important as the protection of potable groundwater. The principle factors effecting proper groundwater protection are the casing design and obtaining a good primary cement job. The overwhelming factor in the success of a primary cement job is the efficiency with which the fluid system in the annular space to be cemented is replaced by the cement alurry. The efficiency is, in turn, effected by many factors such as depth, temperature, pressure, well bore geometry, fluid properties, contact time, fluid density difference, pipe centralization, pipe movement and many others. Commercially available electric logging tools such as the Temperature Log, Radioactive Tracer Survey, Cement Bond Log and Cement Evaluation Tool can be used to substantiate proper groundwater protection. Practical experience and case histories show the successful use of these principles for practical disposal well design and the protection of our groundwater supplies. (See also W87-05071) (Author's abstract)

EVALUATION OF CONFINING LAYERS FOR CONTAINMENT OF INJECTED WASTEWATER,

Missouri Univ.-Rolla. Dept. of Geological Engineering.
For primary bibliographic entry see Field 5E.

REGULATORY STRATEGY GOVERNING THE DISCHARGE OF MINING WASTE TO LAND

IN CALIFORNIA, California State Water Resources Control Board,

Sacramento.

G. Torres Jr., C. Herbst, and J. W. Richards.

IN: Innovative Means of Dealing with Potential
Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water
Quality Symposium, September 26-28, 1984, Las
Vegas, Nevada. National Water Well Association,
500 W. Wilson Bridge Road, Worthington, Ohio,
1984. p 179-192, 3 fig, 3 tab.

Descriptors: *Regulations, *Mine wastes, *California, *Land disposal, *Standards, Waste management, Containment systems, Leachates, Drainage, Groundwater pollution, Monitoring.

Groundwater pollution, Monitoring.

The California State Water Resources Control Board has recently adopted new regulations that apply to discharges at mining waste management units such as waste piles, surface impoundments, and tailings ponds. The regulations contain specific provisions for establishing categories of mining wastes based on an assessment of the potential risk of degrading water quality by each waste group. Depending on the degradation potential by each group, the new regulations specify siting criteria and standards for construction of mining waste management units for the purpose of averting failure of containment structures due to adverse impacts such as those associated with the occurrence of active faults, landslides, and land subsidence. Floodplain siting criteria and construction standards are also provided to ensure that mining waste management units are properly protected from to 100-year frequency flooding. Other standards for construction include those for the design and installation of clay and synthetic liners in combination with leachate collection and removal systems to prevent the movement of fluids, including waste and leachate through those containment structures. Criteria for the design of precipitation and drainage controls are included to accomodate location-specific precipitation events to effectively protect against failures such as waste overflows or washouts. Furthermore, the new regulations specific what mining waste management units be provided with surface and groundwater monitoring systems to obtain an indication of the adequacy of containment structures or if additional requirements are necessary to protect water quality. Provision for proper closure of new and existing mining waste management units are included to ensure the physical and hydraulic integrity of containment structures for as long as wastes pose a threat to water quality. (See also W87-05071) (Author's abstract) W87-05080 The California State Water Resources Control

BACKFILLING TECHNIQUES AND ALKA-LINE ADDITION TO CONTROL ACID MINE DRAINAGE IN A COAL STRIP MINE, Antrim Mining, Inc., Blossberg, PA. For primary bibliographic entry see Field 5E. W87-05082

EVALUATION OF MANAGEMENT PRACTICES FOR MINE SOLID WASTE STORAGE, DISPOSAL, AND TREATMENT, PEDCo-Environmental, Inc., Cincinnati, OH. For primary bibliographic entry see Field 5E. W87-05083

EFFECT OF ARIZONA'S 1980 GROUND WATER CODE ON THE PREVENTION OF GROUND WATER DEGRADATION FROM AG-

Arizona State Dept. of Health Services, Phoenix. A. J. Gordon, D. L. Daniel, and T. M. Turner. In: Innovative Means of Dealing with Potential Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 237-245, 1 fig, 7 ref.

Descriptors: *Arizona, *Water pollution control, *Groundwater pollution, *Groundwater quality, *Agriculture, Evapotranspiration, Irrigation practices, Percolation, Vadose water, Regulations, Groundwater management, Pesticides.

The amount of water evapotranspired by crops is the consumptive use, as this water cannot be recovered. The ratio of the quantity of consumptively used water to the total quantity of water applied is the irrigation efficiency. Deep percolation is inversely proportional to the irrigation efficiency. Deep percolation water is usually of a much lower quality than applied water. This results from the concentration of salts from applied irrigation water through evapotranspiration, and the leaching of chemicals applied to or naturally present in the soil. The 1980 Ground Water Code was created in response to massive overdraft problems in portions of Arizona. The Act created four Active Management Areas. Each farm unit within an AMA will response to massive overdraft problems in portions of Arizona. The Act created four Active Management Areas. Each farm unit within an AMA will be allocated a maximum annual groundwater allocated upon, among other variables, an assigned irrigation efficiency. In subsequent management periods, the assigned irrigation efficiency will be increased, resulting in a subsequent decrease in deep percolation. The practice of overirrigation, resulting in deep percolation may result in groundwater degradation. Reduction of deep percolation through the establishment of regulatory conservation requirements may have the most dramatic long term effect on groundwater quality beneath irrigated lands. Attaining high irrigation efficiencies is a Best Management Practice for preventing groundwater degradation. Pesticide contamination may be caused by 'short-circuiting' mechanisms groundwater degradation. Pesticide contamination may be caused by 'short-circuiting' mechanisms such as inadequate surface seals around wells and cross contamination in the subsurface due to improperly drilled or constructed wells. Well drilling and construction regulations have been developed to prevent this. (See also W87-05071) (Lantz-PTT) W87-05084

VEGETATION MANAGEMENT: A SOLUTION TO SHALLOW GROUND WATER CONTAMINATION IN NORTH-CENTRAL MONTANA, Triangle Conservation District, Coarad, MT.

NATION IN NORTH-CENTRAL MONTANA, Triangle Conservation District, Conrad, MT. B. J. Harrison, J. M. Holzer, and J. D. Farkell. IN: Innovative Means of Dealing with Potential Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Les Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 273-285, 4 fig, 2 tab, 16 ref.

Descriptors: *Vegetation effects, *Groundwater pollution, *Water quality control, *Montana, Groundwater quality, Geohydrology, Salinity, Cultivation, Fallowing, Soil water, Roots.

Cultivation, Fallowing, Soil water, Roots.

Shallow groundwater quality over portions of the Northern Great Plains has degraded considerably over the past 20 to 40 years. Shallow wells in the affected areas have shown a range in total disolved solids (TDS) from 20,000 to 50,000 mg/L. Although the prevalent geologic and climatic conditions are significant, the degradation is attributed to, for the most part, the cultural farming practices of the region. The use of a strict, alternate crop/fallow management practice results in the inefficient use of annual precipitation and allows for the downward migration of subsurface aslts into shallow groundwater systems. In addition, under the right geologic conditions, the salts may resurface and destroy productive cropland in the form of saline seep. It has been estimated that 280,000 (113,300 ha) acres of cropland have been lost to this process in Montana. In north-central Montana, a group of local landowners, in cooperation with state and federal officials, have formed a technical team to address the problem of saline seep and the

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degradation of shallow groundwater quality. An intensive management plan was developed that reclaims salinized cropland and prevents further degradation of groundwater quality. These management approaches require the use of vegetative systems that efficiently use soil moisture and naturally approaches require the use of vegetative systems that efficiently use soil moisture and naturally approaches required the second statement of the second secon aystems that efficiently use soil moisture and natural precipitation in a manner that prevents percolation of water into the shallow groundwater system. The use of a deep-rooted perennial (i.e. afalfa) or change to a flexible cropping program, has led to a significant decrease in the size of saline seeps in as little as 3 to 5 years. In addition, the knowledge gained has led to potential use of vegetative management as a reclamation tool for other water quality problems such as acid mine drainage. (See also W87-05071) (Lantz-PTT) W87-05086

REGULATORY STRATEGY GOVERNING THE DISCHARGE OF HAZARDOUS AND NONHA-ZARDOUS WASTE TO LAND IN CALIFOR-

NIA, California State Water Resources Control Board,

C. M. Herbet, G. Torres Jr., and J. W. Richards. IN: Innovative Means of Dealing with Potential Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 345-357, 2 fig. 3 tab. C. M. Herbst, G. Torres Jr., and J. W. Richards

Descriptors: "Regulations, "Hazardous wastes, "Waste disposal, "California, "Land disposal, Brines, Landfills, Waste dumps, Geohydrology, Water pollution control, Water quality control, Containment systems, Clay, Liners, Leachates.

Revised regulations governing the discharge of waste to land for treatment, storage, or disposal were adopted by the California State Water Re-sources Control Board on May 1, 1984. The regu-lations cover discharges of hazardous waste, 'dessources Control Board on May 1, 1984. The regulations cover discharges of hazardous waste, 'designated' wastes (e.g., nonhazardous brines), and nonhazardous solid waste to landfills, waste piles, surface impoundments, and land treatment units. Regulations governing discharges of hazardous waste were developed as part of California's application to conduct a state hazardous waste control program equivalent to the federal program authorized by the Resource Conservation and Recovery Act. The revised regulations establish classification criteria based on the geologic setting of each waste management unit. Provision governing closure require dischargers to maintain containment and monitoring systems as long as wastes could affect water quality. Site classification criteria for hazardous waste facilities require units to be located where they are isolated from waters of the state by oss waste facilities require units to be located where they are isolated from waters of the state by natural features with low permeability. Combined with construction standards which are more strinwith construction standards which are more stringent than federal standards, the sting criteria result in redundant containment capability for hazardous wastes. Class I units (hazardous waste) are required to have natural geologic isolation, a clay liner, a synthetic liner, and a leachate collection and removal system. Class II units (designated waste) are required to have either natural geologic isolation or a clay liner. Class I and most Class III surface impoundments must be double lined. Class III landfills (nonhazardous solid waste) must have either appropriate natural characteristics to ensure no degradation of water quality or a clay liner. (See also W87-05071) (Lantz-PTT) W87_05090

LABORATORY EVALUATION OF SLURRY WALL MATERIALS OF CONSTRUCTION TO PREVENT CONTAMINATION OF GROUND-WATER FROM ORGANIC CONSTITUENTS, Davis (Ken E.) Associates, Houston, TX K. E. Davis, and M. C. Herring.

In. E. Davis, and M. C. Herring.
In: Innovative Means of Dealing with Potential Sources of Ground Water Contamination. Proceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 491-512, 7 fig. 7 tab, 13 ref.

Descriptors: *Performance evaluation, *Materials testing, *Water pollution prevention, *Water quality control, *Organic compounds, Slurries, Liners, Bentonite, Cements, Path of pollutants, Flow rate, Groundwater movement, Clays, Chlorinated hydrocarbons, Permeability, Alkalinity.

The installation of earthen liners and slurry wall trenches constructed of soils treated with bentonite trencines constructed or soin treated with oentomite and/or bentonite/cement mixtures are frequently used to retard or control the flow of contaminants from surface impoundments and landfill disposal areas. Although effective in reducing the rate of flow of water and some contaminants, standard bentonite treatment is not always effective in conbentonite treatment is not always effective in controlling some types of contaminants, such as chlorinated hydrocarbons. A mixture of soils in the zone of maximum contamination (12 to 25 ft below the surface) in the area of a alurry trench exhibited a permeability of 3.3 times 10 to the -7th cm/sec to water and 0.000031 cm/sec to the concentrated organic waste. A mixture of soil found from the surface down to a depth of 62 ft had a permeability of 2.6 times 10 to the -7th cm/sec to water and 0.000024 cm/sec to organic. The still gray and tan base clay that extends throughout the area was shown to be an effective barrier to the downward migration of the waste. This stiff clay was shown to have a permeability in the range of 4.9 times 10 to the -9th cm/sec and 1.8 times 10 to the -8th cm/sec to water. The clay was impermeable to the to the -9th cm/sec and 1.8 times 10 to the -8th cm/ sec to water. The clay was impermeable to the flow of the concentrated or phased chlorinated hydrocarbon. Standard bentonite soil mixtures using up to 6% or more bentonite were shown to be ineffective in restricting the flow of the concen-trated wastes found in the subsurface strata. How-ever, a 12%/12% bentonite/cement dust soil mixture was shown to completely restrict th movement of the concentrated waste while reduc-ing the flow of groundwater and contaminated leachate. (See also W87-05071) (Lantz-PTT) W87-05098

GROUND WATER QUALITY MANAGEMENT AT A CONCENTRATED WASTE SITE, Henningson, Durham and Richardson, Inc., St.

Petersburg, FL.

J. C. Andrews.

IN: Innovative Means of Dealing with Potential
Sources of Ground Water Contamination. Prosources of tround water Contamination. Proceedings of the Seventh National Ground Water Quality Symposium, September 26-28, 1984, Las Vegas, Nevada. National Water Well Association, 500 W. Wilson Bridge Road, Worthington, Ohio, 1984. p 513-528, 2 fig. 1 tab, 6 ref.

Descriptors: *Water quality control, *Groundwater management, *Water pollution control, *Groundwater pollution, *Water pollution sources, Water pollution prevention, Florida, Lead, Chromium, Aluminum, Leachates, Aquifers, Ammonia, Nitrates, Slurry walls.

The 2100 ton/day Pinelias Resource Recovery Facility lies adjacent to active and closed landfills, and a land application site for studges. Surface water and groundwater in the shallow aquifer are virtually indistinguishable; the water table is near land surface much of the year. An aquiclude, which separates the shallow aquifer from the limestone Floridan aquifer underlies the entire area at an average depth of 90 feet. The aquiclude ranges in thickness from 15 to 80 feet and in conductivity from 10 to the -6th power to 10 to the -9th power cm/sec. Groundwater at the site boundary must meet the Federal Safe Drinking Water Standards (SDWS). In addition, stormwater discharges are subject to strict quality criteria. A comprehensive surface/groundwater monitoring network is now in place. Background water quality in the shallow aquifer indicates that the SDWS are not being met. Water from wells down gradient from old landfills often contains high concentrations of chromium, lead, and aluminum. Water from wells down gradient from old landfills often contains high concentrations of chromium, lead, and aluminum. Groundwater beneath the aludge application site is contaminated by nitrates. Stormwater quality is similarly deteriorated; high concentrations of lead, ammonia, and cadmium are common. The strategy for compliance with these regulations is composed of conceptual and technical solutions. The first step is to organize the pollution sources under a single site permit. Step two is to construct a slurry wall around the entire

site which is keyed into the aquiclude. Step three is to install a drainage system within the wall which conveys water to the plant's cooling system. The final step is to upgrade the site's aeration basin to accept collected leachate. (See also W87-05071) (Author's abstract) W87-05099

INFLUENCE OF IRRIGATION AND NITRO-GEN FERTILIZATION ON GROUNDWATER QUALITY, Science and Education Administration, Lincoln,

NE For primary bibliographic entry see Field 5C. W87-05103

CHANGE OF GROUNDWATER QUALITY IN THE YUN-LIN BASIN DUE TO OVER-PUMP-

National Taiwan Univ., Taipei. Dept. of Agricul-For primary bibliographic entry see Field 4B. W87-05104

STUDY OF IMPROVING GROUNDWATER QUALITY BY DITCH DRAINS AND TUBE WELLS,

Wells, Wuhan Inst. of Hydraulic and Electric Power En-

Wuhan Inst. of Hydraulic and Electric Power Engineering (China).

Z. Weizhen, X. Yupei, and Y. Jingzhong.

IN: Relation of Groundwater Quantity and Quality, Proceedings of a Symposium Held During the XVIIIth General Assembly of the International Union of Geodesy and Geophysics, Hamburg, FR Germany, August, 1983. IAHS Publication No. 146. p 77-89, 14 fig, 5 ref.

Descriptors: *Groundwater quality, *Water quality improvement, *salinity control, *Groundwater management, *Ditch drains, *Tube wells, *Desalination, Infiltration, Model studies, Mathematica analysis, Groundwater movement, Salinity, Saline

matysis, croundwater movement, Salinity, Saline water.

The process of desalinization is discussed, under the condition of ponded leaching and intensified free infiltration in combination with ditch drains. Pumping salty groundwater by tube wells and induced recharge of fresh water from streams or canals was studied by analytical solutions, laboratory experiments on sand tank models and numerical simulation (finite element method). These experiments showed that in uniform fine sands, the longitudinal dispersivity is of negligible value (of the order 10 to the 4th through 10 to the minus 2nd m). The close agreement between experiment and theory based on piston-type salt displacement suggests that dispersion in fine sand can be neglected for practical purposes in the study of salt transport. Reclamation of land can be achieved by ponded leaching in association with ditch drains seven with negligible dispersivity. In the initial stages, desalinization is greatest near the ditch drains sat he displacement front becomes uniform over the cross section between ditches and in equilibrium with the water level of the ditches, there is a rapid decrease in the rate of desalinization. Control of groundwater quality may be accomplished by pumping from tube wells to induce fresh water recharge from streams or canals. The design of these programs for both confined aquifers and those unconfined but with little variation in water table, demands consideration of quifer properties of effective porosity and dispersivity. The rate and extent of desalinization varies directly with dispersivity and inversely with effective porosity. Hydraulic conductivity emerges as an unumportant parameter under these conditions. (See also W87-05107) (Lantz-PTT)

PETROLEUM HYDROCARBONS AND OR-GANIC CHEMICALS IN GROUND WATER -PREVENTION, DETECTION AND RESTORA-TION - A CONFERENCE AND EXPOSITION, National Water Well Association, Worthington,

occeedings of the NWWA/API Conference, No-mber 13-15, 1985, The Westin Galleria, Houston,

Water Quality Control—Group 5G

Texas. National Water Well Association, 6375 Riverside Drive, Dublin, Ohio 43017. 1986. 581 p.

Descriptors: *Groundwater pollution, *Water pollution prevention, *Water pollution sources, *Hydrocarbons, *Conferences, *Water pollution treatment, Groundwater quality, Groundwater movement, Oil pollution, Organic compounds, Ground-

The NWWAY API conference covered a wide range of topics including prevention of groundwater contamination, migration of petroleum hydrocarbons and organic chemicals in groundwater, microbial degradation and physical/chemical transformations in the subsurface, practical applications of groundwater models to transport and fate of contaminants, detecting and delineating underground spills, monitoring program design and implementation, analytical techniques for contaminant recovery systems, the role of enhanced biodegradation in restoration, and control of subsurface hydrocarbon vapors. Government officials, consulting geologists and engineers, researchers, industry representatives and other interested persons met to learn and discuss state-of-the-art techniques employed in preventing, detecting and restoring groundwater contamination resulting from petroleum hydrocarbons and organic chemicals. storing groundwater contamination resulting from petroleum hydrocarbons and organic chemicals. Additionally, the latest in state-of-the-art instru-mentation and equipment was discussed and dis-played. The conference provided a forum for all who attended to companying the addition the conwho attended to communicate and share their experiences in this rapidly developing field. These proceedings are a compilation of papers presented by the symposium speakers. (See W87-05129 thru W87-05164) (Author's abstract)

REGULATOR'S PERSPECTIVE ON PREVEN-TION OF LEAKS FROM UNDERGROUND STORAGE SYSTEMS,

Maine Dept. of Environmental Protection, Augus-

ta. M. Moreau.

M. Moreau.

M. Moreau.

M. Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 1-9.

Descriptors: *Water pollution prevention, *Leaks, *Underground storage, *Groundwater pollution, Storage systems, Water quality control, Regula-

The number and distribution of underground storage tanks poses a threat to groundwater resources and a challenge to all who believe that these resources should be protected. Because underand a challenge to all who believe that these resources should be protected. Because underground storage systems are typically built and maintained to the minimum standards set by regulations, regulatory requirements will play a critical role in preventing leaks from underground storage systems. The task of designing effective regulations is complicated by a variety of factors, including: (1) The wide range of uses for and users of underground storage systems, (2) The vast array of technology available for underground storage, (3) The roist critical role in the properties of the properties of millions of underground tank installations, (4) The need to ensure regulatory compliance, and (5) The constraints imposed by the American business and regulatory climate. The following are suggested as ingredients of a successful tank management strategy: (1) Cooperation and close communication between regulators and the regulated community, (2) Education of tank owners, installers, operators and regulators as to the nature and scone of the problem and the tank owners, installers, operators and regulators as to the nature and scope of the problem and the technical and regulatory approaches to dealing with the problem, (3) Developing effective standards for new tank installations which provide a level of protection proportional to the value of the resource being protected, (4) Developing means of monitoring existing installations for timely detection of leak incidents, and (5) Developing a strategy to locate and deal with improperly abandoned tanks. In designing regulations, the most important factor to consider is implementability. Because of the vast number of installations involved, this

means establishing mechanisms within regulations which will be simple, self-regulating, and require a minimum of paperwork. While such goals are admittedly idealistic, they are none the less worth striving for. (See also W87-05128) (Author's abstract) stract) W87-05129

RCRA PERMITTING: CASE HISTORIES, ACLS, TRICHLOROETHYLENE AND PENTACHLOROPHENOL, Sweet, Edwards and Associates, Inc., Kelso, WA. J. E. Edwards, and G. Rosenthal.

IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 10-27, 9 fig, 5 tab, 7 ref.

Descriptors: *Path of pollutants, *Organic compounds, *Case studies, *Regulations, Chemical analysis, Groundwater pollution, Trichloroethy-lene, Pentachlorophenol, Plumes, Volatile organics, Fate of pollutants, Water pollution effects.

iene, Pentachiorophenol, Plumes, Volatile organics, Fate of pollutants, Water pollution effects. Alternate Concentration Limits under RCRA were developed for two industrial sites. Both sites occur on fluvial sediments with shallow groundwater. One involves volatile organic contaminants while the other concerns pentachlorophenol (PCP). Field investigations were completed to characterize the uppermost aquifer and determine the extent of contamination. Principal focus is on the evaluation of exposure pathways. In both cases, field data is combined with statistical and analytical evaluations to predict plume movement. In the case of the volatile organic contaminant plume, the choice of an exposure point was based on owner policy and technical analysis. The resultant exposure point some 1000 feet downgradient of the source allowed the development of ACLs at concentrations (60 ppm) far in excess of health criteria (approximately 0.010 ppm) as a result of the effects of degradation, adsorption and dispersion. In the PCP site case, the exposure point was identified as the site compliance boundary and the most recent health criteria were used directly. Predicted movement and attenuation were used primarily as a cross check on the low risk for other pathways. In both cases, the analysis involved a considerable exercise of judgement in assessing pathways, physical processes, and health risks. The results of these assumptions may have considerable impact on, and feedback from, issues relating to the costs associated with remedial action and clean-up. No general formula is likely to be useful in a wide variety of cases since the contaminants, aquifer characteristics, physical setting, and, perhaps most important, the policy perceptions of the site owner may vary widely. (See also W87-05128) (Lantz-PTT)

SAMPLING FOR TRACE LEVEL DISSOLVED HYDROCARBONS FROM RECOVERY WELLS RATHER THAN OBSERVATION WELLS,

Amoco Corp., Tulsa, OK.
L. E. Dunlap.
IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 223-235, 13 fig, 1 ref.

Descriptors: *Hydrocarbons, *Water sampling, *Recovery wells, Groundwater pollution, Monitoring, Groundwater quality, Aquifers.

When liquid hydrocarbons leak into subsurface sediments, a common technique is to install obser-vation wells and one or more recovery wells to recover the liquid hydrocarbons from the subsurrecover the liquid hydrocarbons from the subsur-face. Once the maximum amount of liquid hydro-carbons have been recovered from the subsurface, it is usually desirable to monitor the concentration of dissolved hydrocarbons in the area where the liquid hydrocarbons existed. Water samples can either be collected from observation wells or from the discharge pump from the recovery well. Groundwater samples collected from the discharge

of the groundwater depression pump represent the water quality of the aquifer from the water table surface to the total depth of the recovery well. In contrast, dissolved hydrocarbon samples collected from an observation well usually represent the water quality of the aquifer in the uppermost part of the aquifer where the groundwater has been in of the aquifer where the groundwater has been in contact with liquid hydrocarbon residuals. Residual hydrocarbons cling to the well screen, gravel pack and aquifer sediments. Groundwater in con-tact with liquid hydrocarbon residuals will have a high concentration of dissolved hydrocarbons that is not representative of the entire aquifer. In con-trast, residual hydrocarbons have a minor effect on trast, residual hydrocarbons have a minor effect on the groundwater semples collected from the dis-charge of the recovery well. Therefore, ground-water samples collected from the discharge of the recovery well are more representative of dissolved hydrocarbons in the aquifer than samples collected from observation wells which previously con-tained liquid hydrocarbons. (See also W87-05128) (Lantz-PTC) (Lantz-PTT) W87-05143

PUMPING FROM MULTIPLE WELLS REDUCES WATER PRODUCTION REQUIRE-MENTS: RECOVERY OF MOTOR VEHICLE FUELS, LONG ISLAND, N.Y., New York State Dept. of Transportation, Hyde Park. Region 10. For primary bibliographic entry see Field 5F. W87-05152

TOLUENE LOSS INVESTIGATION AND RE-MEDIAL ACTION AT TWO GEOLOGICALLY COMPLEX INDUSTRIAL SITES IN EASTERN

NEBRASKA, Hoskins-Western-Sonderegger, Inc., Lincoln, NE. For primary bibliographic entry see Field 5B. W87-05153

DESIGN, INSTALLATION AND OPERATION OF WITHDRAWAL WELL CONTAMINANT RECOVERY SYSTEMS,

RECOVERY SYSTEMS,
Davis (Ken E.) Associates, Baton Rouge, LA.
J. Fleniken, and W. Landry.
IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and
Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston,
Texas. 1986. p 397-405.

Descriptors: *Design standards, *Water pollution treatment, *Installation, *Withdrawal wells, *Recovery systems, Cleanup operations, Groundwater pollution, Water pollution treatment, Aquifers, Flow measurement, Water level.

As concern for and emphasis upon the environ-As concern for and emphasis upon the environ-ment continues to grow, more and more attention is being given to the cleanup or remediation of waste sites. This has been particularly true as evi-denced by the ever increasing number of 'Super Fund' attest which are currently being identified and addressed with regard to cleanup. Many of the sites under review and cleanup, whether 'Super Fund' or otherwise, are ones which have a very high potential for adversely impacting shallow groundwater supplies. As a result, the withdrawal mgn potential for adversely impacting station groundwater supplies. As a result, the withdrawal well is becoming increasingly important as a major tool in many cleanup operations. The withdrawal well design should be site specific and its use should be tailor-made to accomplish the intended objectives. Prior to design and installation, there should be a thorough understanding of site specific should be a thorough understanding of site specific geology, hydrology and topography. If the well is to be used for remedial purposes, serious consideration should be given to the type of contaminants involved and materials of construction should be selected accordingly. Detailed studies of the aquifer yield should be made to develop the most efficient and cost effective operation. In the case of remedial wells, extreme care should be given to proper installation to avoid cross contamination, additional damage to the environment, and the proper in additional proper installation to avoid cross contamination, additional damage to the environment, and the training and safety of the personnel involved in both installation and operation. Provision should be made in the design of the system for adequate and accurate measurement of flows, concentra-

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tions, and water levels. Wherever possible, contin-uous recording should be used to facilitate accu-rate reporting. Finally, operation and maintenance of the well system is very critical and should begin with design and installation. Once the withdrawal well in placed on line, every effort should be made to be a continuously to maximize its to keep it operating continuously to maximi potential. (See also W87-05128) (Lantz-PTT) W87-05154 ize its

ADVANTAGE OF UTILIZING MULTIPLE RE-COVERY WELLS FOR AQUIFER RESTORA-TION,

er Technology, Inc., Concord, CA.

w. Smith.

In: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 406-420, 7 fig.

Descriptors: *Recovery wells, *Aquifers, *Groundwater quality, *Water pollution treatment, Aquifer management, Hydrocarbons, Clean-up operations, Pump wells, Path of pollutants, Fate of pollutants, Cost analysis.

ap operations, Pump wells, Path of pollutants, Fate of pollutants, Cost analysis.

A case study depicts a groundwater remediation system designed and installed to contain and abate the groundwater degradation associated with the inadvertant release of petroleum product to a major potable aquifer. The multiple pumping well abatement program was successful at controlling the dissolved contaminant plume migration while recovering the free floating product plume. The dissolved plume has been observed to be controlled and reduced since initiation of the pumping program. The water treatment system operated as originally designed with the exception of the addition of the soluble polyphosphate reagent to reduce the scaling problems. The treatment system has consistently reduced influent concentrations to <100 ppb total hydrocarbons as required. The utilization of multiple pumping wells should be considered when abating groundwater contamination problems in very high water producing aquifers and very low permeable formations. Aquifers that yield high production rates for water wells are conducive to rehabilitation by use of multiple pumping wells, as the installation of additional wells may permit greater control over ontaminant movement and expedite abatement while minimizing total pumping rates. The cost of the additional pumping wells may be offset by the benefits of minimizing the dewatering effects on already overdeveloped aquifers and the reduction of the time involvement of the abatement project. In case of contaminants in low permeable formations, the use of multiple pumping wells may be required to easure adequate hydrological control of the contaminant plume. One pumping wells may be required to easure adequate hydrological control of the contaminant plume. One pumping wells may be contaminant plume of the tastement project. In case of contaminant plume. One pumping wells may be required to easure adequate hydrological control of the contaminant plume. One pumping wells may be contamined to easure adequate hyd

DEGRADATION OF AROMATIC HYDROCAR-BONS WITH BACTERIA FROM OIL CON-TAMINATED AQUIFERS, Technical Univ. of Denmark, Lyngby. Dept. of Sanitary Engineering.
For primary bibliographic entry see Field 5B.
W87-05156

IN SITU BIOSURFACTANT PRODUCTION: AN AID TO THE BIODEGRADATION OF ORGANIC GROUND WATER CONTAMINANTS, Tetra Tech, Inc., Pasadena, CA. S. B. Wilson.

IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston,

Texas. 1986. p 436-444, 1 fig. 1 tab, 21 ref.

Descriptors: *Biosurfactants, *Fate of pollutants, *Biodegradation, *Organic compounds, *Groundwater pollution, Water pollution treatment, Oil pollution, Petrophysics, Water quality, Oxygen, Endogenous bacteria, Temperature, Pressure, Geochemistry.

In recent years, worldwide attention has been given to the contamination of groundwater resources by petroleum and related organic compounds. With the realization that many conventional remedies for handling polluted groundwater are inadequate, alternative methods of in situ treatare madequate, atternative memors or in situ accument are being sought that do not require the costly steps of contaminated water removal and transportation. In situ biodegradation is one such treatment alternative. This technology makes use treatment alternative. This technology makes use of bacteria, endogeneous or introduced, to break down organic pollutants within the aquifer itself. Some important characteristics of aquifer systems where this method may be applied are: contaminant characteristics, petrophysical characteristics, water quality, oxygen concentration, endogenous bacteria, temperature and pressure, and geochemistry. It is the focus of this paper to bring attention to the developing technology of biosurfactant production. This technology has the potential to enhance the degradation of organic pollutants in aquifer environments by greatly improving hydrocarbon dispersion and bacterial attachment to these contaminants. (See also W87-05128) (Lantz-PTT) W87-05152) W87-05157

BIOTRANSFORMATION OF PETROLEUM HYDROCARBONS IN DEEP UNSATURATED

HYDROCARBONS IN DEEP UNSATURATED SEDIMENTS,
Geraghty and Miller, Inc., Oak Ridge, TN.
P. D. Kuhlmeier, and G. L. Sunderland.
IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 445- 462, 3 fig, 5 tab, 13 ref.

Descriptors: *Biodegradation, *Water pollution treatment, *Oil pollution, *Hydrocarbons, *Unsaturated sediments, Cleanup operations, Gasoline, Groundwater pollution, Soil contamination, Benzene, Aerobic conditions, Bacteria, Hydrogen ion concentration, Temperature, Chemical analysis.

Biodegradation can be used as a very effective Biodegradation can be used as a very effective cleanup technique for gasoline components in contaminated soil and groundwater. At 20 C in a well-mixed, aerated environment, the USEPA priority pollutant gasoline components tested, with the exception of beazene, were reduced to below detection limits (LOD = 1.0 ppb) within 6.8 hours in all respirometer vessels tested using the endigenous microbial flora. For benzene, concentrations were reduced more than 99.9% in the biological test vessels; a 37.5% reduction was observed in the abiotic control. In soils recovered from relatively deep locations the aerobic bacterial populations deep locations the aerobic bacterial populations thrive at sufficient quantities to allow significant reduction of hazardous constituents. External turrive as sufficient quantities to allow significant reduction of hazardous constituents. External oxygen sources appear to be required to produce economical results. Venting application is currently underway at the site to provide an external oxygen source. Based on these results, biological treatment is a viable technique to environmentally restore the soil and groundwater contaminated with gasoline in deep unsaturated sediments. Biological treatment would involve the following: (1) Nutrient addition to support the growth of an increased bacterial population; (2) Maintenance of pH within a range optimal for bacterial growth (pH 6-8); (3) Maintenance of a minimum temperature of 50 F in the biological treatment system and in all areas on the site requiring biological treatment; and (5) Monitoring biological activity and chemical parameters throughout the system. (See also W87-05128) (Lantz-PTT)

FEASIBILITY OF TREATING CONTAMINATED GROUND WATER AT A HAZARDOUS WASTE SITE,

GCA Corp., Bedford, MA. GCA Technology For primary bibliographic entry see Field 5D. W87-05161

SUBSURFACE VENTING OF VAPORS EMA-NATING FROM HYDROCARBON PRODUCT ON GROUND WATER,

ON GROUND WATER,
Radian Corp., Austin, TX.
W. L. Crow, E. P. Anderson, and E. M. Minugh.
IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and
Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston,
Texas. 1986. p 536-554, 6 fig, 3 tab, 2 ref.

Descriptors: *Vapors, *Hydrocarbons, *Ground-water pollution, *Ventilation, Vapor recovery, Quantitative analysis, Qualitative analysis, Moni-toring, Water pollution treatment.

An American Petroleum Institute sponsored pilotscale subsurface venting system study was performed to evaluate the effectiveness of forced venting techniques in controlling and removing hydrocarbon vapors from a subsurface formation. Both qualitative and quantitative sampling and analysis procedures developed to measure hydrocarbon vapors extracted from soil are described. Vapor recovery and equivalent liquid product recovery rates measured at varying test cell evacuation rates are provided. Two identical test cells were installed. Each cell contained 16 vapor monitoring probes spaced at distances from 4 to 44 ft from a vapor extraction (vacuum) well. Each cell was also configured with two air inlet wells to allow atmospheric air to enter the subsurface formation. The vapor monitoring probes were installed at three discrete elevations above the capillary zone. The soil venting techniques evaluated during this study offer an alternative approach for controlling and eliminating spilled or leaked hydrocarbons from sand or gravel formations of high porosity and moderate permeability. The results of this field study indicate that soil venting techniques can be effective in controlling and eliminating hydrocarbon vapors from the unsaturated vadose zone. Baseline soil vapor measurements at the site revealed that the hydrocarbon vapors were located primarily in a narrow zone 2 to 3 ft above the capillary zone. A substantial decrease in the soil hydrocarbon vapor concentrations was observed during the first 1-2 days of venting during each experiment. The most dramatic reduction in soil hydrocarbon vapor concentrations was observed at probes positioned on the centerline between the at probes positioned on the centerline between the vapor recovery wells and the air inlet wells. Measureable reductions in the hydrocarbon vapor concentration were observed at distances of 50 ft from the vapor recovery well during each low flow experiment. The results clearly demonstrate that the time required to draw down the hydrocarbon vapors in the vadose zone was much shorter than the time required for vapor concentrations to reestablish to original baseline levels. (See also W87-05128) (Lantz-PTT)

SOIL DECONTAMINATION THROUGH IN SITU AIR STRIPPING OF VOLATILE ORGAN-ICS - A PILOT DEMONSTRATION,

ICS - A PILOT DEMONSTRATION,
Weston (Roy F.), Inc., West Chester, PA.
M. F. Coia, M. H. Corbin, and G. Anastos.
IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and
Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston,
Texas. 1986. p 555-564, 3 fig, 2 tab.

Descriptors: *Soil contamination, *Volatile organics, *Pilot tests, *Air stripping, Water pollution treatment, Decontamination, Soil characteristics, Chemical analysis, Model studies.

The contamination of soils and groundwater from past waste solvent handling and disposal practices has been identified as one of the predominant envi-ronmental concerns throughout the nation. Numer-ous industrial locations and abandoned hazardous

WATER RESOURCES PLANNING—Field 6

Water Demand—Group 6D

waste sites are plagued with solvent-related contamination problems resulting from chlorinated volatile organics in the soil and groundwater. Due to the mobility and volatility of most chlorinated volatile organics, control of the contaminant source area is difficult, and long-term impacts on groundwater quality are prevalent. While groundwater treatment is widely understood and practiced as a cleanup strategy, soil decontamination or treatment techniques are still handled as innovative technologies. The primary accepted alternatives for mitigating volatile organic soil contamination have involved either site isolation through capping or excavation with ultimate disposal in an appropriate landfill facility. A field demonstration of one such innovative technique for soil decontamination, in situ air stripping of chlorinated volatile organics from identified solvent-contaminated soils was conducted on a pilot scale. The project demonstrated that trichlorethylene can be effectively removed through the use of forced air ventilation systems in situ air stripping may have application where volatile organic contaminants are of primary concern from a remedial action standpoint. Some potential limitations, however, should be noted, since additional research is required in the following general areas: The effects of various soil types and the presence of perched water zones on air stripping effectiveness is unknown; Detailed laboratory-scale investigations are needed to evaluate contaminant migration potentials for various soil types and chemical constituents; Air emissions modelling is needed to assess critical contaminant concentrations in the exhaust gases as well as the regulatory requirements for exhaust air emissions treatment. (See also W87-05128) (Lantz-PTT) W87-05163

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

INTEGRATED, MULTI-FUNCTIONAL APPROACH TO WATER RESOURCES MANAGEMENT,

Thames Water Authority (England). Northern Div.

D. G. Jamieson. Hydrological Sciences Journal HSJODN, Vol. 31, No. 4, p 501-514, December 1986. 4 fig, 9 ref.

Descriptors: *River basins, *Water resources management, *Optimization, *Planning, *Long term planning, *Management planning, *Multiobjective planning, *Simulation analysis, Mathematical studies, United Kingdom.

Water resources management is defined in its broadest terms and deemed to encompass all water related aspects of river basin management and from long term planning through to real time operational control. Bearing in mind the increasing pressure on finite resources, an integrated, multifunctional approach is advocated in which different analytical procedures are used at the various stages of decision making. These include mathematical programming, large scale simulation, and optimal control theory. By way of example, the application of these techniques to water resources in the United Kingdom is briefly described. It is recommended that future theoretical work should place more emphasis on ease of application. (Author's abstract) W87-04561

INTERNATIONAL COOPERATION IN WATER RESOURCES MANAGEMENT - HELP-ING NATIONS TO HELP THEMSELVES, United Nations Educational, Scientific and Cultural Organization, Paris (France). Div. of Water Sciences.
For primary bibliographic entry see Field 6F. W87-04562

PLANNING MODEL FOR OPTIMAL HYDRO SYSTEM EXPANSION, Helsinki Univ. of Technology, Espoo (Finland).

Control Engineering Lab.
P. Lautala, H. Valisuo, and M. Autti.
International Water Power and Dam Construction
IWPCDM, Vol. 38, No. 10, p 33-39, October 1986.
10 fig, 2 tab, 11 ref.

Descriptors: *Mathematical models, *Planning, *Optimization, *Management planning, *Hydroelectric power, *Computer programs, *Hydroelectric plants, Reservoirs, Performance evaluation.

Expansion planning of hydropower systems with hydraulically connected powerplants is discussed, with emphasis on the capacity to cover daily load variations through the year. Production curves are presented for the evaluation of weekly average production. Two methods, optimal loop control and closed loop control, are presented for the determination of the operation strategy of the system and use of the results to determine optimal harnessing of the system is shown. An interactive minicomputer program package was developed based on the present methods, and its results for a system of 5 reservoirs and 10 plants are presented. (Author's abstract)

MANAGEMENT OF WATER RESOURCES -ROLE OF THE WATER SUPPLIERS, For primary bibliographic entry see Field 5F. W87-04788

DISTRIBUTION AND TRANSPORTATION OF WATER - THE PRESENT STATE OF THE ART AND A LOOK INTO THE FUTURE, For primary bibliographic entry see Field 5F. W87-04789

6B. Evaluation Process

INTEGRATED, MULTI-FUNCTIONAL AP-PROACH TO WATER RESOURCES MANAGE-MENT, Thames Water Authority (England). Northern Div. For primary bibliographic entry see Field 6A. W87-04561

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

OPTIONS FOR FINANCING ACID RAIN CONTROLS, Georgia Univ., Athens. Inst. of Natural Resources. J. L. Regens, and R. W. Rycroft. Natural Resources Journal NRJOAB, Vol. 26, No. 3, p 519-549, Summer 1986. 5 tab, 79 ref.

Descriptors: *Acid rain, *Rainfall, *Water pollution control, *Air pollution control, *Financing, *Economic aspects, *Political aspects, Political restraints, Policy making, Scientific aspects.

Acid rain, the common term for the wet and dry processes for the deposition of acidic inputs into ecosystems, has become the focus of much scientific research and has become an issue of environmental concern. Scientific and economic aspects of acid rain were reviewed and some cost estimates were presented. Various alternatives for financing control costs, including the electric utility ratemaking process which is one of the more common-legal discussed financial alternatives, were detailed. The alternatives to the electric utility ratemaking process are generally less economically efficient, but may allocate the cost over a broader segment of the population. The political implications of the alternatives were discussed and patterns of interest group mobilization and interaction were presented. (Wood-PTT)

OVERVIEW OF GRANTS FOR SEWERAGE FACILITIES, For primary bibliographic entry see Field 5D. W87-04809

RECENT SEWAGE FINANCING IN PENNSYL-VANIA, Collings, Legg, Mason, Inc., Philadelphia, PA. For primary bibliographic entry see Field 5D. W87-04310

ECONOMICS OF REMOTE METER READ-ING, Northern Illinois Water Corp., Champaign. For primary bibliographic entry see Field 5F. W87-04906

6D. Water Demand

AGRICULTURAL WATER DEMAND IN NORTHEAST LOUISIANA, 1982-2000, Louisiana State Univ., Baton Rouge. Dept. of Agricultural Economics and Agribusiness. S. A. Henning.
Louisiana Agriculture, Vol. 30, No. 1, p 14-15, Autumn 1986. 1 tab.

Descriptors: *Louisiana, *Water demand, *Agricultural water demand, *Soybeana, *Cotton, *Irrigation efficiency, *Water conservation, Economic aspects, Commercial catfish production, Prediction, Aquaculture, Fisheries.

a study was conducted of agricultural crop water demand in 11 northeast Louisiana parishes (Caldwell, Catahoula, Concordia, East Carroll, Frank-lin, Madison, Morehouse, Ouachita, Richiand, Tensas, West Carroll). Future demand for target years 1990 and 2000 were projected under two scenarios: (1) with current irrigation technology and average rainfall conditions and (2) with the same conditions, except that water conservation methods are applied to increase irrigation efficiency. The results indicated economic potential for expanding irrigation of crops and aquaculture in northeast Louisiana. Under current cost and price relationships, there seems to be considerable room for growth in irrigated soybeans and cotton. The potential for commercial catfish production has not been determined for the study area, but is expected to expand in response to processing and marketing improvements. (Rochester-PTT)

ESTIMATION OF THE SHARE OF EACH WATER SOURCE FOR ADULTS IN FRANCE: WATER INTAKE PROVIDED TO FRENCH ADULTS,

WATER INTAKE PROVIDED TO FRANCISCA ADULTS, BSN S.A., Paris (France). J. M. Antoine, C. Magliola, F. Couzy, G. Darret, and J. P. Mareschi. Annals of Nutrition and Metabolism ANUMDS, Vol. 30, No. 6, p 407-414, November-December 1986. 2 fig, 5 tab, 18 ref.

Descriptors: "Water distribution, "Water sources, "Adult water use, "Water use, "Drinking water, "Potable water, France, Endogenous water, Food habits, Beverages, Tap water use.

The approximate amount of the different water intakes for an adult population consuming 11.8 MJ/day (2,837 kcal/day), where 1.4 MJ (337 kcal) are provided by beverages, is calculated to be 2.7 liter/day. These intakes include: (1) 'invisible intakes' supplied by endogenous water (348 ml/12.9%) and water contained in food, fruit or dairy products (1,008 ml/37.6%), and (2) 'visible intakes' provided by water contained in commercialized beverages such as bottled water, fruit juices, sodas, fruit drinks, alcoholic drinks (678 ml/25.3%) and tap water (estimate/650 ml/24.2%). We advise that consumption studies be carried out according to the various age brackets. (Author's abstract) W87-04600

TRENDS IN THIRD WORLD HYDRO DEVEL-OPMENT, For primary bibliographic entry see Field 8A. W87-04782

POLICY RELEVANCE IN STUDIES OF URBAN RESIDENTIAL WATER DEMAND,

Field 6—WATER RESOURCES PLANNING

Group 6D-Water Demand

Arizona Univ., Tucson. Dept. of Agricultural Eco-

W. E. Martin, and J. F. Thomas

Water Resources Research WRERAQ, Vol. 22, No. 13, p 1735-1741, December 1986. 3 fig, 1 tab,

Descriptors: *Policy making, *Urban areas, *Water demand, *Water supply, *Domestic water, *Mathematical models, *Model studies, *Demand elasticity, Pricing, Economic aspects, Water use, Residential water use, Comparison studies.

A large number of studies of the demand for urban water have appeared in the literature. The discus-sions have focused on the variables to include in the model in addition to water quantity and price, the best functional forms to use in statistical estima-tion, the turne of detailed. the best functional forms to use in statistical estima-tion, the types of data used, and the magnitudes of the estimated price and income elasticities. The basic interest has been in estimates of elasticities. Inormally measured and reported only at the mean of price and quantity). Precise estimates of demand elasticities for a given area may not be necessary for policy purposes. Given the general nature of the demand for urban water, simple cross-sectional comparisons of prices and quantities in similar areas may be most reliable for policy use. Short-run elasticities give little information for policy purposes. Comparison of well-defined price and quantity data from four cities (Coober Pedy and Ferth, Australia, and Phoenix and Tucson in Ariquantity data from four cities (Coober Pedy and Perth, Australia, and Phoenix and Tucson in Ari-zona) and one small country (Kuwait) with similar arid environments suggests a long-run price elastic-ity for residential water of about -0.5 over a wide range of water prices. The potential for price adjustments to affect use is enormous. (Alexanderjustme PTT) W87-04939

EMERGENCY WATER PLANNING PRO-

a Dept. of Health and Human Resources, New Orlean

For primary bibliographic entry see Field 6E. W87-04998

6E. Water Law and Institutions

FULL SPEED AHEAD: WATER RESOURCES BILL PUMPS MONEY AND ENERGY TO CORPS,

P. Hoffman, and B. Lamb.

Engineering News-Record ENREAU, Vol. 217, No. 18, p 13-14, October 30, 1986.

Descriptors: *Construction, *Water law, *Water Resources Bill, *Corps of Engineers, *Legislation, *Management planning, Pumped-storage, Flood control, Powerhouses, Dredging, Lock and dam facilities, Rehabilitation, Personnel.

The recently passed \$16.3 billion omnibus water resources bill includes at least 70 new starts of resources bill includes at least 70 new starts of Corps of Engineers projects. Of 262 new starts and studies authorized, 189 are subject to review by the Corps of Engineers and the Secretary of the Army. Among those most likely to be approved are pumped-storage projects, flood control projects, additional powerhouses, dredging and deepening of channels, and new lock and dam facilities. A new feature of the omnibus bill is the establishment of a 5-yr obligation ceiling for construction, the 1987 ceiling is \$1.4 billion, with \$100 million increases in the ceiling each year until 1990, when it reaches \$1.8 billion. The approval of this legislation came just in time to prevent staff cuts according to Bory Steinberg, chief of the Corps's policy, review, and initiatives division. (Rochester-PTT) W87-04372

ADAPTIVE MANAGEMENT: LEARNING FROM THE COLUMBIA RIVER BASIN FISH AND WILDLIFE PROGRAM.

Washington Univ., Seattle. For primary bibliographic entry see Field 6F. W87-04436 REEXAMINING THE PARITY PROMISE: MORE CHALLENGES THAN SUCCESSES TO THE IMPLEMENTATION OF THE COLUM-BIA BASIN FISH AND WILDLIFE PROGRAM, Lewis and Clark Coll., Portland, OR. Natural Resources Law Inst. M. C. Blumm.

M. C. Biumin. Environmental Law, Vol. 16, No. 3, p 461-515, Spring 1986. 263 ref.

Descriptors: *Columbia River Basin Fish and Wildlife Program, *Northwest Power Act, *Northwest Power Planning Council, *Pacific Northwest, *Water law, *Fish, Salmon, Trout, Fish passages, Environmental protection.

The Columbia Basin Fish and Wildlife Program is the centerpiece of continuing efforts to preserve and restore salmon and steelhead runs in the Northwest. The directives of the Northwest Power Act which authorized the program and evaluates the first three-and-a-half years of program implementation, including amendments adopted by the Northwest Power Planning Council in 1984, 1985, and 1986 are examined. Several impending threats to successful implementation, ranging from constitutional challenges to the Council, to electric power exports to California, to widespread reluctance on the part of federal water project operators and regulators to carry out various program provisions are surveyed. It was concluded that these threats, along with the Northwest Power Planning Council's reluctance to approve increased fish passage protection in 1986, indicate as uncertain future for the program and its restoration goals. (Author's abstract) in Fish and Wildlife Program is The Columbia Bas

MISPLACED ROLE OF COST-BENEFIT ANALYSIS IN COLUMBIA BASIN FISHERY MITIGATION,

R. C. Lothrop. Environmental Law, Vol. 16, No. 3, p 517-554, Spring 1986. 141 ref.

Descriptors: *Cost-benefit analysis, *Columbia River Basin, *Fish and Wildlife Coordination Act, *Northwest Power Act, *Water law, *Fish, Salmon, Trout, Fish migration, Spawning, Hydro-electric power, Pacific Ocean, Treaty rights.

Prior to the 1850's, the Columbia River Basin produced eleven to sixteen million salmon and produces televin a street minute among among and steelhead; today it produces two and one-half mil-lion. As many as eighty percent of the juvenile fish migrating from headwater spawning and rearing areas to the Pacific Ocean will perish en route due areas to the racine Ocean win persail are touce our to hydroelectric project impacts. Post mitigation efforts, intended to offset these impacts, have been hampered by erroneous interpretations of the Fish and Wildlife Coordination Act, which subjected fisheries mitigation to the litmus test of cost-benefit analysis. Distributive effects, inconsistent with the treaty fishing rights of the Columbia River Indian tribes, ensued from these economic analyses. The Northwest Power Act underscores the primacy of sound biological objectives over considerations of cost and offers the opportunity to make whole the injuries suffered by the fisheries of the Columbia River Basin. (Author's abstract) W87-04438

FERC'S MID-COLUMBIA PROCEEDING: TEN

YEARS AND STILL COUNTING, National Oceanic and Atmospheric Administra-tion, Seattle, WA. Office of General Counsel. F. L. Bodi.

mental Law, Vol. 16, No. 3, p 555-581, Spring 1986. 149 ref.

Descriptors: *Federal Energy Regulatory Commission, *Columbia River, *Water law, *Fish, Salmon, Trout, Indian tribes, Hydroelectric power, Licensing, Environmental protection, Dame

The Federal Energy Regulatory Commission's (FERC) mid-Columbia proceeding had its roots over ten years ago, when state and federal fishery agencies and Indian tribes formally requested mitigation for the impacts of five Public Utility District (PUD) dams. These dams take a considerable

toll on salmon and steelhead populations in the Columbia River, a toll which was largely unaddressed when the PUD dams were originally licensed. The development of the mid-Columbia proceeding is traced. The issues and the positions of the parties are outlined, and the key administrative milestones in the proceeding are highlighted. It was concluded that in the interest of the fishery resource, effective interim steps leading to long-term fish protection measures are still needed at all five PUD dams. Further, if the fishery resource is nive PUD dams. Further, if the fishery resource is to be adequately protected at new hydroelectric projects, FERC must establish fish protection conditions at the same time power approvals are granted through license issuance. Only in this way can the delays in fish mitigation inherent in the mid-Columbia proceeding be avoided. (Author's ab-

SMALL SCALE HYDROPOWER AND ANAD-ROMOUS FISH: LESSONS AND QUESTIONS FROM THE WINCHESTER DAM CONTRO-

Lewis and Clark Coll., Portland, OR. Natural Re-

Lewis and Clark Coll., Portland, OR. Natural Resources Law Inst.
M. C. Blumm, and B. Kloos.
Environmental Law, Vol. 16, No. 3, p 583-637,
Spring 1986. 279 ref.

Descriptors: *Hydroelectric power, *Federal Energy Regulatory Commission, *Water law, *Na-tional Marine Fisheries Service, *National Envi-ronmental Policy Act, Construction, Dams, Oper-ations, Licensing, Environmental protection.

The authors use the authorization of the controversial Winchester project on Oregon's North Umpqua River as a case study to examine federal and state regulatory schemes governing small-scale hydropower. Between 1982 and 1985 this 1.5 and state regulatory schemes governing small-scale hydropower. Between 1982 and 1985 this 1.5 megawatt project received state and federal approvals, was constructed, and experienced two years of troubled operation before it was shut down. The authors show how the project led the Oregon Legislature to reform the state's standards for hydroelectric permits, and how it induced the Federal Energy Regulatory Commission to interpret away the ability of the National Marine Fisheries Service to prescribe binding conditions on projects qualifying for exemptions from federal licenses. They also explain why FERC's failure to satisfy the requirements of the National Environmental Policy Act caused the project to shut down in December 1985, and they make detailed recommendations as to how the federal program authorizing small hydroelectric projects can comply with NEPA. The authors argue that federal and state fishery agencies should insist the Winchester project not restart until FERC prepares an environmental impact statement on the effects of the project and a proposed replacement dam on the project and a proposed replacement dam on the North Umpqua's anadromous fish runs. (Author's abstract) W87-04440

REVIVING THE FEDERAL POWER ACT'S COMPREHENSIVE PLAN REQUIREMENT: A HISTORY OF NEGLECT AND PROSPECTS FOR THE FUTURE, Lewis and Clark Coll., Portland, OR. Natural Re-

D. H. Cole.

Environmental Law, Vol. 16, No. 3, p 639-671, Spring 1986. 184 ref.

Descriptors: *Federal Power Act, *Hydroelectric Descriptors: "Federal Power Act, "Hydroelectric power, "Federal Power Commission, "Federal Energy Regulatory Commission, "Water law, "Fish, Licensing, Administration, Legislation, River basins, Environmental protection, Compre-hensive planning.

In 1920, Congress enacted the Federal Power Act (FPA) to secure inexpensive and widely available power through federal licensing of private hydroelectric development in accordance with a 'comprehensive plan'. The Federal Power Commission (FPC) was charged with administering the statute and undertook its planning obligations with diligence, preparing plans for at least two river basins.

WATER RESOURCES PLANNING—Field 6

Water Law and Institutions—Group 6E

However, chronic manpower and resource deficiencies soon led the FPC to neglect Congress'
planning directive. No comprehensive plans have
been produced since 1930, either by the FPC or its
successor, the Federal Energy Regulatory Commission (FERC). This failure to plan, combined
with the avalanche of hydro-license applications
caused by recently enacted federal subsidies, has
exposed serious flaws in FERC's licensing process,
flaws which result in haphazard development and
inefficient dedication of basin-wide resources, including anadromous fish. The flaws in federal hydropower licensing resulting from FERC's refusal
to plan for development are examined, explicates
the benefits of comprehensive planning, and the
history of federal hydropower legislation is traced.
This history proves that Congress intended the
FPC and FERC to prepare 'real' plans before
permitting or licensing projects. Finally, current
efforts in Congress and the courts to reinforce the
FPC and FERC to prepare 'real' plans before
permitting or licensing projects. Finally, current
efforts in Congress and the courts to reinforce the
FPC and FERC to prepare 'real' plans before
permitting or ricensing projects. Finally, current
efforts in Congress and the courts to reinforce the
FPC and planning mandate are examined. The author
concludes that comprehensive plans offer the best
hope for rational decision making about the future
of the nation's river resources. (Author's abstract)
W87-04441

CUMULATIVE IMPACTS OF HYDROPOWER DEVELOPMENT UNDER NEPA, Hart, Crowser and Associates, Inc., Seattle, WA. D. K. Eckberg. Environmental Law, Vol. 16, No. 3, p 673-703, Spring 1996 132 sef. Spring 1986. 123 ref.

Descriptors: *Environmental impact, *Hydroelectric power, *National Environmental Policy Act, *Water law, *Federal Energy Regulatory Commission, River basins, Construction, Fish, Dams, Administration, Licensing.

Federal legislation aimed at encouraging the development of renewable energy resources has produced an unprecedented national hydropower boom, leading hydropower project developers to propose the construction of multiple projects on single river basins throughout the country. Other users of the river basins and federal and state lanning agencies have become increasingly consingle river to sains shroughout the country. Other users of the river basins and federal and state planning agencies have become increasingly concerned that the cumulative effects of these projects might destroy important river resources such as migrating fash stocks, wildlife, and recreational pursuits. The Federal Energy Regulatory Commission (FERC) is responsible for authorizing these projects. It is suggested that to comply with NEPA and thereby eliminate the unnecessary degradation of important river resources, FERC should assess hydropower development on a basin-wide scale, considering the cumulative impacts of all hydropower preliminary permits, licenses, exemptions, and non-hydropower activities affecting common river resources. (Author's abstract) W87-04442

EVOLUTION OF A NEW COMPREHENSIVE PLAN FOR MANAGING COLUMBIA RIVER ANADROMOUS FISH,

Lewis and Clark Coll., Portland, OR. Natural Resources Law Inst.

Sources Law Inst.
P. H. Harrison.
Environmental Law, Vol. 16, No. 3, p 705-729,
Spring 1986. 105 ref.

Descriptors: *Columbia River, *Indian treaty rights, *United States-Canada Pacific Salmon Treaty, *Pacific Northwest, *Water law, *Conservation, *Fish, Salmon, Trout, Economic aspects, Cultural aspects, Environmental protection, Comprehensive planning.

After years of unresolved litigation pitting state conservation regulations against Indian treaty rights, Oregon, Washington, Idaho, and the treaty tribes are negotiating a new plan to manage Columbia River anadromous fish. Current circumstances including certification of the United lumbia River anadromous fish. Current circum-stances, including certification of the United States-Canada Pacific Salmon Treaty, increased emphasis on salmon and steelhead production, and a growing mutual respect between parties, favor the successful development and implementation of this plan. If the plan succeeds, it could provide a model for the comprehensive management of a migratory resource across both geographical and cultural boundaries. The history of the conflict between the states and the tribes is reviewed and the evolution of a comprehensive management plan for Columbia River salmon and steelhead trout is traced. The author concludes that a resolu-tion of remaining political problems is both possi-ble and imperative for the survival of a resource that has long been a significant part of the history, culture, and economy of the Pacific Northwest. (Author's abstract) W87-04443

FEDERAL ENVIRONMENTAL REGULATION IN CANADA,

British Columbia Univ., Vancouver. Policy Analy-P. N. Nemetz.

Natural Resources Journal NRJOAB, Vol. 26, No. 3, p 551-608, Summer 1986. 20 tab, 258 ref.

Descriptors: *Environmental control, *Pollution control, *Environmental policy, *Environmental protection, *Regulations, *Canada, *Federal regulation, United States, Federal jurisdiction, Legal

An overview and assessment of federal environ-mental regulation in Canada is presented along with contrasts and similarities with the U.S. system. It was concluded that, despite the activity of most provincial governments in the area of pollution control, a continuing federal presence is required to maintain an effective system of envi-ronmental protection. Although certain features of the Canadian approach suggest, in principle, a higher degree of economic efficiency and adminis-trative effectiveness than the U. S. model, Canadi-na environmental control remains imperfect and incomplete. The structure of environmental regula-tion in Canada was reviewed and seven issues which bear directly on the assessment of the system, particularly in relation to the role of the system, particularly in relation to the role of the federal government, were discussed. (Wood-PTT) W87-04569

COUNTERING ENVIRONMENTAL CRIMES, Department of Justice, Washington, DC. Environmental Crimes Unit.

J. W. Starr. Boston College Environmental Affairs Law Review BCERDX, Vol. 13, No. 3, p 379-395, 1986. 51 ref.

Descriptors: *Water law, *Environmental crimes, *Water pollution control, *Water pollution prevention, *Legal aspects, *Environmental protection, Protection, Protection, Protection, Environmental policy, Public policy, Regulations, Administrative regulations.

A summary of the history behind the establishment of environmental protection statutes was presented. These statutes attempt to balance industrial needs with the important goal of protecting the public health and welfare while preserving natural resources. They reflect a new and widespread public concern which demands a strong response to environmental abuse including criminal sanctions for violations of enacted environmental laws and permitting incarceration among the allowed penalties. Federal programs, statutes, acts, and several sample cases were reviewed. (Wood-PIT) W87-04659 A summary of the history behind the establishment

GABCIKOVO-NAGYMAROS BINATIONAL PROJECT.

For primary bibliographic entry see Field 8A. W87-04776

PUBLIC RELATIONS FOR THE PUBLIC WATER SUPPLY IN YEARS TO COME, For primary bibliographic entry see Field 5F. W87-04785

OVERCOMING A SEWER MORATORIUM, For primary bibliographic entry see Field 5D. W87-04805 FUNCTIONS AND ACTIVITIES OF GROUND-WATER PROTECTION: IMPLICATIONS FOR INSTITUTIONAL COORDINATION,

Oklahoma Univ., Norman. Environs Ground Water Inst. L. Canter.

The Environmental Professional, Vol. 8, No. 3, p 219-224, 1986, 4 ref.

Descriptors: *Groundwater management, *Water quality control, *Governmental interrelations, Institutions, Financing, Groundwater development, Groundwater pollution, Jurisdiction, Legal as-

Program functions and activities and various policy issues associated with institutional coordination for groundwater protection programs are given. Multiple functions and activities of a state or local groundwater protection program, needs of institutional coordination based on program functions and activities, general observations relative to the functions and activities of a groundwater protection program and activities of a groundwater protection program and key policy issues are the functions and activities of a groundwater protection program, and key policy issues are covered. The seven key institutional policy issues identified are: (1) coordination among governmental entities, (2) the need for technical as well as policy oriented information, (3) finding appropriate methods for achieving an optimum mix of funding sources, (4) problems of groundwater resource ownership, (5) institutional coordination between those with groundwater quantity responsibilities and those whose responsibility is groundwater quality, (6) additional technical issues (underground storage tanks, groundwater quality standards, aquifer classification), and (7) problems of jurisdiction for groundwater resources that cross political boundaries and resolving the disputes between jurisdictions with conflicting groundwater protection programs. (Rochester-PTT)

EFFECTIVENESS AND EQUITY OF GROUND-WATER MANAGEMENT METHODS IN THE WESTERN UNITED STATES,

Clark Univ., Worcester, MA. J. L. Emel, and T. Maddock.

The Environmental Professional 225-236, 1986. 4 fig. 1 tab, 22 ref. al, Vol. 8, No. 3, p

Descriptors: *Water law, *Groundwater development, *Water resources development, *Property rights, Groundwater potential, *Groundwater management, *Management planning, Western

Property rights protection and aquifer develop-ment management are the primary goals of groundwater management agencies in the western United States. A variety of implementation strate-gies are used to foster these sometimes conflicting coals. Some strategies are more discretionary than gies are used to foster these sometimes conflicting goals. Some strategies are more discretionary than others; some are more encouraging of local decisionmaking; some are intended to promote renewal rather than depletion of groundwater resources. Management approaches are classified and evaluateer leading water level response to pumping patterns and aquifer characteristics, allowing an assessment of the potential of each method for effective and equitable attainment of the primary goals. A management method that limits the cumulative drawdown caused by well interference and the rate of nonpumping (static) water level decline may be the most effective and equitable. (Author's abstract)

PAPER DAM: THE ROLE OF THE INTERNA-TIONAL JOINT COMMISSION IN THE RESO-LUTION OF THE SKAGIT RIVER-HIGH ROSS DAM CONTROVERSY,

DAM CONTROVERST, Saint Lawrence Univ., Canton, NY. A. M. Schwartz. The Environmental Professional, Vol. 8, No. 3, p 237-243, 1986. I fig. 23 ref.

Descriptors: *Water law, *Jurisdiction, *Interna-tional agreements, *Boundary disputes, *Adjudica-tion procedure, *Skagit River, *High Ross Dam, United States, Canada, Riparian waters, Dams.

Field 6-WATER RESOURCES PLANNING

Group 6E-Water Law and Institutions

The U.S.-Canada International Joint Commission (IJC) has used standard practices of fact finding to help resolve transboundary environmental issues for over 70 yr. The recently changing approaches of the IJC are examined in the context of its role in resolving the Skagit River-High Ross Dam controversy between Seattle, Washington, and the Province of British Columbia. The city of Seattle had gained approval from both the IJC and the necessary U.S. regulators to raise the Ross Dam on the Skagit River and thus flood over 5,007 acres in British Columbia; it also had a signed agreement from the province. After decades had passed, Seattle moved to raise the dam and B.C. objected on the grounds of unacceptable environmental damage and poor economic compensation. The IJC was asked by the province to set a most dangerous precedent and reverse its previous order of approval. The IJC used new approaches in creating a Special Joint Consultative Group and carving out a new role for itself as facilitator of a negotiated settlement. The settlement created a 'paper dam' in that Seattle received the power the dam would have provided and B.C. received compensation equal to the cost of the dam. This new role of the IJC and what this may mean for future environmental issues such as acid rain is discussed. (Author's abstract) W87-04816

SAFE DRINKING WATER LAW TOUGHENED, Environmental and Energy Study Inst., Washing-ton, DC.

100, DC. 10. Ketcham-Colwill. Environment ENTVAR, Vol. 28, No. 7, p 5, 42-43, September 1986. 8 ref.

Descriptors: *Safe Drinking Water Amendments of 1986, *Water quality, *Safe Drinking Water Act of 1974, Legislation, *Regulation, *Water law, *Drinking water, *Contamination, *Standards, *Water supply systems, Filtration, Lead, Well regulations, Environmental Protection Agency, *Planching Acuifors* ulations, Environ. Plumbing, Aquifers.

The Safe Drinking Water Act of 1974 was substantially strengthened by a recently approved reauthorization act intended to address several problems identified in the enforcement of drinking water regulations. The Safe Drinking Water Amendments of 1986 require the Environmental Protection Accepts to more guickly set standards. Amendments of 1986 require the Environmental Protection Agency to more quickly set standards for chemicals in drinking water and mandate state action to protect the groundwater tapped by public water system wells. Public water systems are required to use best available technology to remove contaminants and monitor chemicals that are not currently regulated. Enforcement of drinking water regulations and rules governing waste disposal through underground injection wells are also strengthened. Additional features of the reauthorization act include an 18 month deadline for EPA to issue regulations requiring filtration or other equally protective measures by public water systems that rely on rivers or other surface water sources, a ban on the use of lead pipes, solder and tems that rely on rivers or other surface water sources, a ban on the use of lead pipes, solder and flux in the installation or repair of public water systems and a requirement for state establishment of wellhead protection areas around wells in public drinking water systems where pollutants could flow down into underground formations containing water supplies. (Michael-PTT)

INDUSTRIAL WASTE REDUCTION: THE ANDUSTRIAL WASTE REDUCTION: THE PROCESS PROBLEM,
New York State Energy Research and Development Authority, New York.
For primary bibliographic entry see Field 5E.
W87-04824

NITRATES IN GROUND AND DRINKING WATER: ANALYSIS OF POLICIES AND REG-ULATIONS, International Inst. for Environment and Society,

Berlin (Germany, F.R.).
For primary bibliographic entry see Field 5G.
W87-04854

RESTRICTIVE SPECIFICATIONS.

M. F. Lunch. Water Engineering and Management WENMD2, Vol. 133, No. 11, p 14-15,17, November 1986. 6 ref.

Descriptors: *Engineering, *Engineering specifica-tions, *Water law, *Water treatment, *Specifica-tions, *Standards, *Economic aspects, *Legal as-pects, Environmental Protection Agency, Court decisions, Costs.

A design engineer should be allowed to specify products and equipment which are best suited to meet the objectives of a project, but recently public agencies have become more cost conscious and have been influenced by the emphasis on competition as a means of holding down costs. Several sample court cases were presented which demonstrated a trend shifting toward open material and equipment specification, rather than allowing the engineer to make the decision. The Environmental Protection Agency has promoted the concept that a brand name specification will be tolerated if coupled with an or equal clause, and a bidder for the contract must be allowed to bid non-specified equipment. Court decisions on cases involving specifications which were so restrictive that they prevented substitution of equipment for the brand specified were reviewed. It was concluded that engineers must now pay much more attention to engineers must now pay much more attention to the impact of the competition atmosphere than previously when they were permitted to use their professional judgement in writing material and equipment specifications. (Wood-PTT) W87-04979

MANAGING INDIA'S ENVIRONMENT,

S. Jasanoff.
Environment ENTVAR, Vol. 28, No. 8, p 12-16,31-38, October 1986. 1 tab, 34 ref.

Descriptors: *India, *Environment, *Environment tal policy, *Environmental protection, *Legal aspects, *Ecology, Public policy, Protection, Environmental quality.

Legislative and administrative apparatus for controlling environmental threats in India were reviewed. New legislation, including the new environmental protection law enacted in May 1986, strengthened the legal framework for pollution control and provided authority for complete management of toxic and hazardous substances. However, major problems arise in implementation since the institutional and technological infrastructures required to make legal instruments function more effectively are missig in many parts of the country. The central government lacks the funds and the legal and political authority to enforce the laws. The difficulties and India's unique strengths were discussed. (Wood-PTT)

EMERGENCY WATER PLANNING PRO-

Louisiana Dept. of Health and Human Resources,

New Orleans.
F. Hull, and T. J. Ray.
Southwest and Texas Water Works Journal
STWJDV, Vol. 168, No. 8, p 5, November 1986.

Descriptors: *Water emergencies, *Planning, *Emergency planning, *Water management, *Surveys, *Administrative agencies, *Water supply, *Water use, Resources management, Computers, Public health.

The U. S. Army Corps of Engineers was directed by the President of the United States to take the leadership role in the development, coordination, and implementation of an emergency water plan. The plan being developed will describe in detail the water management responsibilities, procedures, and actions of the Corps and other federal, state, and local agencies for various types of water emergencies. The Corps' New Orleans District is responsible for developing the plan for the state of Louisiana. An important component of the plan is a statewide inventory of water and wastewater systems. To fill data gaps and to update water use a statewise inventory of water and wastewater systems. To fill data gaps and to update water use data available to the state, a water use survey is beingr developed jointly by the Corps and the

Louisiana Department of Health and Human Resources. Participation is urged, since it is the most important ingredient for assuring that public water systems continue to serve safe drinking water during emergencies. (Author's abstract) W87-04998

REGULATORY STRATEGY GOVERNING THE DISCHARGE OF MINING WASTE TO LAND IN CALIFORNIA, California State Water Resources Control Board,

Sacramento. For primary bibliographic entry see Field 5G. W87-05080

RCRA PERMITTING: CASE HISTORIES, ACLS, TRICHLOROETHYLENE AND PENTACHLOROPHENOL, Sweet, Edwards and Associates, Inc., Kelso, WA. For primary bibliographic entry see Field 5G. W82.04120

6F. Nonstructural Alternatives

ADAPTIVE MANAGEMENT: LEARNING FROM THE COLUMBIA RIVER BASIN FISH AND WILDLIFE PROGRAM, Washington Univ. Seasts

Washington Univ., Seattle. K. N. Lee, and J. Lawrence. Environmental Law, Vol. 16, No. 3, p 431-460, Spring 1986. 76 ref.

Descriptors: *Adaptive management, *Columbia River Basin Fish and Wildlife Program, *North-west Power Planning Council, *Fish, *Water law, *Hydropower development, Salmon, Trout, Policy making, Environmental protection, Wild-life, Governmental interrelations.

Adaptive management is a policy framework designed to meet the unusual requirements of the Columbia River Basin Fish and Wildlife Program of the Northwest Power Planning Council. The program attempts to substantially rebuild salmon and steelhead trout populations decimated by more than half a century of hydropower development. This unprecedented effort now comprises the world's largest program of biological restoration. The major challenge facing the program is biological uncertainty. Knowledge of existing fishing stocks and practices is imperfect. Restoration on the scale contemplated has not been previously attempted. Yet Congress clearly intended for action to be taken promptly. Adaptive management emphasizes the learning opportunities implicit in protecting and enhancing fish and wildlife by treating program measures as experiments, it is possible to proposed with solvith solvithe subtilities with the prosedule with solvithe subtilities with the procedule with the procedule with the subtilities with the procedule with the procedu It in protecting and enhancing fish and wildlife. By treating program measures as experiments, it is possible to proceed with rebuilding while learning how to do so more effectively in the future. Disciplined implementation of the Columbia Basin program can reap significant benefits for fish and wildlife, complementing advances in management of salmon harvest that have been achieved recently by state and tribal fisheries agencies. (Author's abstract) abstract) W87-04436

REEXAMINING THE PARITY PROMISE: MORE CHALLENGES THAN SUCCESSES TO THE IMPLEMENTATION OF THE COLUMBIA BASIN FISH AND WILDLIFE PROGRAM, Lewis and Clark Coll., Portland, OR. Natural Re-For primary bibliographic entry see Field 6E. W87-04437

MISPLACED ROLE OF COST-BENEFIT ANALYSIS IN COLUMBIA BASIN FISHERY MITIGATION, For primary bibliographic entry see Field 6E. W87-04438

FERC'S MID-COLUMBIA PROCEEDING: TEN YEARS AND STILL COUNTING, National Oceanic and Atmospheric Administra-tion, Seattle, WA. Office of General Counsel.

Network Design-Group 7A

For primary bibliographic entry see Field 6E. W87-04439

INTERNATIONAL COOPERATION IN WATER RESOURCES MANAGEMENT - HELPING NATIONS TO HELP THEMSELVES, United Nations Educational, Scientific and Cultural Organization, Paris (France). Div. of Water Sciences J. S. Gladwell.

Hydrological Sciences Journal HSJODN, Vol. 31, No. 4, p 515-527, December 1986. 6 ref, append.

Descriptors: *International cooperation, *Water resources development, *Managment planning, *Developing countries, *Water resources planning, *Education

Assistance to developing nations in the area of water resources has shown mixed successes and failures. A major factor is the capacity of the receiving nations to make good use of the resources provided at their stage of development their absorbative capacity. Programs must be tailored to the situations. This requires planning that is specific to the national and cultural context, as well as careful sensitivity to positive interaction with those who be expected to implement programs whose real purpose should be to allow the entire population, especially the poor, to become socially effective and self aware as well as more productive and comfortable. It also requires careful preparation in the way of education, science and institutional responsiveness. Experts and government leaders must reconsider their approaches to the problem so that nations can learn and think for themselves. (Author's abstract)

6G. Ecologic Impact Of Water Development

CUMULATIVE IMPACTS OF HYDROPOWER DEVELOPMENT UNDER NEPA, Hart, Crowser and Associates, Inc., Seattle, WA. For primary bibliographic entry see Field 6E. W87-04442

DIFFERENTIAL TEMPERATURE SENSITIVITY OF TWO CLADOCERAN SPECIES TO RESOURCE VARIATION DURING A BLUE-GREEN ALGAL BLOOM, Oklahoma Univ., Kingston. Biological Station. For primary bibliographic entry see Field 2H. W87-04457

DENITRIFICATION IN MARL AND PEAT SEDIMENTS IN THE FLORIDA EVER-GLADES, Old Dominion Univ., Norfolk, VA. Dept. of Biological Scien For primary bibliographic entry see Field 2H. W87-04458

PUMPED-STORAGE STATIONS AND THE LIFE OF HYDROBIONTS, I. E. Dyachuk, O. G. Kaftannikova, I. E. Zhdanova, N. V. Koval', and V. I. Scherbak. Hydrotechnical Construction HYCOAR, Vol. 22, No. 12, p 269-272, May 1986. 1 tab, 1 ref. Translat-ed from Gidrotekhnicheskoe Stroitel'stvo No. 5, p 12, 14 May 1986. 12-14, May 1986.

Descriptors: *Species diversity, *Pumped stora; *Chlorophyll, *Phytoplankton, *Zooplankto*Reservoir fisheries, Kiev, Soviet Union, Alpigments, Pheopigments, Biomass, Aquatic orinisms, Reservoirs, Fish.

The consequences of operating the Kiev Pumped-Storage Station (PSS) on dissolved oxygen concentration, phytoplankton, acoplankton, and fishes was examined. A higher ratio of pheopigments:chlorophyll a was found near the intake station compared to a control station, indicating some breakdown of algal pigments as a result of PSS operations. However, the working

storage of the PSS reservoir is only 0.001 of the water mass of the Kiev reservoir. A marked decrease in the number of zooplankton species was noted between the lower reservoir at the intake and the upper reservoir. As a result of operating the PSS, up to 99% of the zooplankton dies, but new zooplankton takes the place of the biomass lost in system operations. No economically valuable or 'trash' species of fish are noticeably damaged by reservoir operations. (Rochester-PTT) W87-04767

LOW-HEAD HYDRO ON THE AUSTRIAN DANUBE, Cesterreichische Donaukraftwerke A.G., Vienna. For primary bibliographic entry see Field 8A. W87-0471

DESIGNING HYDRO RESERVOIRS TO PRE-VENT TROPICAL DISEASES, Blue Nile Associates, Foxboro, MA. For primary bibliographic entry see Field 8A. W87-04773

ENVIRONMENTAL IMPACT OF THE SANMEN GORGE PROJECT, Scientific and Technological Information Inst., Beijing (China).
W. Xuitao.

W. Xiutao. International Water Power and Dam Construction IMPCDM, Vol. 38, No. 11, p 23-24, November 1986. 5 fig. 2 ref.

Descriptors: *Sediment accumulation, *Hydroelectric plants, *Dam, *Agriculture, *China, *Samme Gorge project, *Environmental effects, Reservoirs, Backwater deposits, Central Shaanti Plain, Floods, Ice jams, Groundwater levels, Waterlogging, Saline soils, Sediment flushing, Subsidence.

The Sanmen Gorge project, which was planned to be a 1200 MW project on the Yellow River (China), failed to meet this target because of rapid, unanticipated sedimentation of the reservoir beginning in 1960. Backwater deposits raised the river bed above the dam, causing serious impacts on farmland in the Central Shaanxi Plain. The project did, however, provide valuable control of ice jaminduced floods below the dam. Groundwater levels around the reservoir rose, giving rise to salinization and waterlogging, cave-in of water wells, ground subsidence, the collapse of some buildings, and disruption of the ecosystem. Modifications of the reservoir to permit sediment flushing have substantially reduced the amount of sediment accumulation. Today the Sanmen Gorge project serves as a useful example of why a thorough environmental impact study should be conducted prior to implementation of similar sized projects. (Rochester-PTT) ter-PTT) W87-04774

HYDRO AND THE ENVIRONMENT: EVALU-ATING THE TRADEOFFS, International Bank for Reconstruction and Devel-opment, Washington, DC.

opment, Washington, 2001.
R. Goodland.
International Water Power and Dam Construction IWPCDM, Vol. 38, No. 11, p 25-28, 33, November 1986. 16 ref.

Descriptors: "Hydroelectric power, "Water projects, "Environmental effects, "Tradeoffs, Dumoga irrigation project, Franklin River hydro project, Sient Valley hydro project, Nam Choan hydro project, Tasmania, Australia, India, Naramada River basin development, Indonesia, Thailand, Developing countries.

Environmental tradeoffs exemplified by the Dumoga irrigation project (Indonesia), the Franklin River hydro project (Irasmania, Australia), Silent Valley hydro project (India), and the Nam Choan hydro project (Thailand) are described, and the following environmental aspects of water projects are discussed: resettlement, health, wildland loss, water quality, fish and fisheries, cultural property, economics, and the role of mini-hydro. The Naramada River basin (India) development

program is described in some detail, including the way various environmental concerns are being adressed. Environmental precautions are available, affordable, feasible, and tested, and their implementation can prevent damage and mitigate environmental costs. (Rochester-PTT)

HABITAT USE OF IRRIGATED LANDS BY CALIFORNIA QUAIL IN NEVADA, Wildlife and Nevada Univ., Reno. Dept. of Range Forestry.
D. P. Stinnett, and D. A. Klebenow.
The Journal of Wildlife Management, Vol. 50, No.
3, p 368-372, July 1986. 3 tab, 11 ref.

Descriptors: *Quail, *Irrigated land, *Nevada, *Wildlife habitats, Wildlife management, Land use, Flood plains, Land management.

The relationship between California quail and the use of irrigated flood plain lands in western Nevada was studied. Quail preferred field borders to any other cover type during all seasons. Field borders comprised less than one percent of available habitat yet received more than 30% of total use of feeding and loafing cover and more than 25% of total use as escape cover. Coveys and broods selected areas containing significantly more forb canopy cover than did pairs. Pairs selected areas with significantly more shrub cover than did broods and coveys. It was concluded that quail populations on irrigated lands could be improved through better management of field borders and maintenance of adjacent shrub lands. (Author's abstract)

IMPLICATIONS OF MARSH SIZE AND ISO-LATION FOR MARSH BIRD MANAGEMENT, Iowa State Univ., Ames. Dept. of Animal Ecol

gy. M. Brown, and J. J. Dinsmore. The Journal of Wildlife Management, Vol. 50, No. 3, p 392-397, July 1986. 2 fig, 1 tab, 28 ref.

Descriptors: "Model studies, "Species diversity, "Wildlife habitats, "Population dynamics, "Waterfowl, "Marshes, Prairies, Spatial distribution, Regression analysis, Isolation, Iowa.

The number of breeding bird species in 30 Iowa prairie marshes ranged from 2 to 17 per marsh during 1983 and 1984. All marshes were similar in physical characteristics, except for size and isolation from other marshes. A two variable regression model containing size and isolation accounted for 75% of the variation in species richness. Ten of the 25 species did not occur in marshes greater than 5 hectares. Species richness often was greater in wetland complexes than in large isolated marshes. Marsh size and isolation are important wildlife habitat management considerations. (Author's abstract) stract) W87-04872

ARE EUCALPYTS ECOLOGICALLY HARM-FUL. For primary bibliographic entry see Field 4C. W87-04886

7. RESOURCES DATA

7A. Network Design

HYBRID METHOD FOR SEASONAL STREAMFLOW FORECASTING, Asian Inst of Tech, Bangkok (Thailand). H. N. Phien, and J. Wei-Haw. Water S. A. WASADV, Vol. 12, No. 3, p 109-118, July 1986. 2 fig. 14 tab, 12 ref.

Descriptors: *Mathematical models, *Regression analysis, *Streamflow forecasting, *Time series analysis, *Hybrid method, *Seasonal storage, *Streamflow, Mekong Basin, Tachia Basin, Reservoirs, Catchment areas.

Field 7—RESOURCES DATA

Group 7A-Network Design

The amount of water stored in a reservoir can be utilized more efficiently if it is possible to forecast future inflows. However, not many techniques for seasonal streamflow forecasting have been devised. Recently, a particular scheme has been introduced, in which regression analysis is used in model idensification and parameter estimation, and a time series approach is used in providing forecasts with long lead times. Because of this combination, the scheme has been referred to as the Hybrid Method. In this study, the Hybrid Method is evaluated along with its two simplified versions through practical applications to monthly streamflow forecasting. It is found that the Hybrid Method and these simplified versions produce satisfactory forecasts for stations with large drainage areas. However, for stations with small drainage areas they seem to perform very poorly. (Author's abstract) W87-04480

CONCEPTUAL DESIGN FOR A GROUND-WATER QUALITY MONITORING STRATEGY,

WALER QUALITY MOUNTORING STRATEGY, Iowa Univ., Iowa City. R. Rajagopal. The Environmental Professional, Vol. 8, No. 3, p 244-264, 1986. 2 fig. 12 tab, 47 ref.

Descriptors: "Management planning, "Model studies, "Groundwater management, "Monitoring, "Water quality control, "Aquifers, Groundwater pollution, Land use, Ecology, Public health, Cost analysis.

A conceptual design for a groundwater quality monitoring strategy based on assigning weights to prior information and other potential contributing factors is proposed and illustrated. It is further refined and formulated as a specific case of a 0-1 integer programming model for allocating monitoring resources efficiently. Types of monitoring are ambient, self, compliance, and consumer protection. Design of monitoring seeks to address the questions of what, where, and when and how often to monitor. Major factors governing monitoring activities are sources of contamination, land use, and aquifer vulnerability; health and ecological effects; population exposure; statistical behavior of and aquater voluntrationity; nearin and ecological effects; population exposure; statistical behavior of contaminants in groundwater; cost of sampling, analysis, and quality assurance; and regulations. (Rochester-PTT)

SIMPLE MODEL FOR SPATIAL-TEMPORAL

PROCESSES, Stanford Univ., CA. Dept. of Statistics. For primary bibliographic entry see Field 2A. W87-04970

DESIGN OF NATIONAL, REAL-TIME WARN-ING SYSTEMS WITH CAPABILITY FOR SITE-SPECIFIC, FLASH-FLOOD FORECASTS, lowa Univ., Iowa City. Dept. of Civil Engine

mg. K. P. Georgakakos. Bulletin of the American Meteorological Society BAMIAT, Vol. 67, No. 10, p 1233-1239, October 1986. 1 tab, 36 ref.

Descriptors: *Flash floods, *Floods, *Flood forecasting. *Rainfall-runoff relationships, *Warning systems, *Prediction, Runoff, Forecasting, Projections, Design criteris, Networks.

Presented are necessary requirements of a modern-day flash flood warning system that is capable of site-specific forecasts and that is suitable for national implementation. The requirements are identified based on the hydrometeorological character of the flash-flood phenomenon and on the real-time nature of the forecast procedure. Contemporary theories of heavy-rainfall and runoff generation and development are reviewed. Floods require co-ordinated efforts in several areas for their accurate prediction. This is in accordance with present-day plans for large-scale, coordinated meteorological and hydrological experiments in the mesoscale to be conducted in the United States. The proposed enhancement of the observation networks should provide information to improve our understanding of hydrometeorological processes and of their coupling in nature. (Wood-PTT)

W87-04976

DIFFERENT NEEDS BREED MANAGE-MENT'S HEED,

American Water Works Service Co., Inc., Haddon Heights, NJ. P. Hersch.

Water Engineering and Management Vol. 133, No. 11, p 12, November 1986. ent WENMD2,

Descriptors: *Measuring instruments, *Water treatment, *Systems engineering, *System instrumentation, *System planning, Long-term planning, Short-term planning, Planning, Equipment, Instru-

Utilities have different instrumentation needs which must be taken into account when installing or upgrading their systems. Management considerations should include: system/instrument harmony, long- and short-term objectives, equipment reliability, and personnel acceptance. Each of these factors was discussed and related to overall system design. Proper instrumentation was considered esential for supplying the facts needed for an efficient utility management system and for cost-effective operation. (Wood-PTT)

7B. Data Acquisition

DEVICE FOR SAMPLING THE MUD-WATER INTERFACE IN EUTROPHIC LAKES AND BOGS FOR RESIDUE ANALYSIS, Simon Fraser Univ., Burnaby (British Columbia). Dept. of Biological Sciences.

M. Noble, P. C. Oloffs, R. So, J. Yee, and F. Yuen. Journal of Environmental Science and Health (B) JPFCD2, Vol. 21, No. 5, p 359-373, 1986. 3 fig, 8 ref.

Descriptors: *Samplers, *Sampling, *Sediment analysis, *Sediments, *Mud-water interface, *Eutrophic lakes, *Bogs, *Sediment samplers, Performance evaluation, Field tests.

A tubular sampler was developed to obtain layered samples of loosely-aggregated, flocculent sediments from bogs and eutrophic lakes. The samples obtained are up to 50 cm long and 15 cm in diameter. The sampler is free from protuberances, permitting intact, layered samples to be taken. The device is about 85 cm long. A pneumatic closing mechanism is used that is controlled from above the water surface. An extendible handle for manipulating the sampler and for guiding it into place is fastened to the upper end of the sampling tube. The performance and operation of the sampler in the field are described. (Rochester-PTT) W87-04381 W87-04383

MONITORING OF ABIOTIC COMPART-MENTS FOR TRACE METALS: DIFFICUL-TIES, STRATEGIES AND USE OF SURVEYS, ds Inst. voor Onderzoek der Zee, Texel. C. J. M. Kramer.

Environmental Monitoring and Assessment EMASDH, Vol. 7, No. 2, p 169-187, September 1986. 7 fig, 3 tab, 50 ref.

Descriptors: *Wadden Sea, *North Sea, *Monitoring, *Trace metals, *Sampling strategy, Statistics, Sediment deposition, Sediment resuspension, Reference stations, Oceanography.

Based on surveys of the Dutch Wadden Sea and North Sea, the problems of monitoring dissolved and particulate fractions in the water and the sediments are discussed. Topics include: deposition/resuspension, effect of resuspension on particulate and dissolved concentrations, frequency and density of sampling, strategies for monitoring of water and sediments, and the use of surveys for monitoring. The low concentrations of trace elements in marine waters demand strict sampling and sample handling procedures, which makes routine sampling unlikely to be carried out on a routine basis. High variability in both dissolved and particulate constituents may cause monitoring results to be

difficult to interpret. At least one (reference) sta-tion should be established at which many param-eters (major and minor constituents, physical pa-rameters) should be collected in frequencies of lays to weeks to improve knowledge of the behi days to weeks to improve knowledge of the behav-ior of many components under various environ-mental conditions. Because variability is less in open sea areas, monitoring there should be over many station with lower frequency. Monitoring of sediments should be limited to areas with a net deposition, if possible in undisturbed sedi (Rochester-PTT) W87_04384

COMMENTS ON FLUOROMETRIC CHLORO-PHYLL DETERMINATIONS IN THE FIELD, Hanover Univ. (Germany, F.R.). Inst. fuer Bio-

D.E. W. Ernst. Archiv fuer Hydrobiologie AHYBA4, Vol. 107, No. 4, p 521-527, October 1986. 3 fig, 1 tab, 28 ref.

Descriptors: *Fluorometry, *Spectral analysis, *Measuring instruments, *Chlorophyll, *Algae, Photosynthesis, Limnology, Lake Steinhuder Meer, Eutrophic lakes, Fluorescence methods, Calibrations, Correlation analysis.

The in-vivo-chlorophyll-fluorescence of algae at 680 nm is quenched by the electron transport chain of photosynthesis. Hence the potential turnover of the chain could be estimated by observing the fluorescence difference between the blocked (with fluorescence difference between the blocked (with chlorophenyl-dimethyl-urea (CMU)) and unblocked chain (deltaF sub CMU). The fluorescence of the blocked chain (F sub CMU) should give a measure for the total chlorophyll-a content. These correlations were tested in a limno-corral-experiment in August 1980 in lake Steinhuder Meer (shallow, z = 1.35m, eutrophic) with a particularly designed field fluorometer and found to apply rather well; F sub CMU versus primary productivity over quantum flux: r = 0.95, deltaF sub CMU versus primary productivity over quantum flux: r = 0.83. The results did not cover changes in physiological state or species composition as would be expected between different regions, seasons or lakes. Colony forming algae showed deviations due to selfabsorption. The fluorescence methods require calibration by classical methods, however, they are simple, quick and cheap and apt for automatization. (Author's abstract) stract) W87-04411

SECCHI DISK SCIENCE: VISUAL OPTICS OF

NATURAL WATERS,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental

Lab. R. W. Preisendorfer.

Limnology and Oceanography LIOCAH, Vol. 31, No. 5, p 909-926, September 1986. 1 fig, 2 tab, 22

Descriptors: *Secchi disks, *Turbidity, *Optical properties, *Reviews, Water quality, Water depth, Calibrations, Light penetration, Euphotic zone, Estimating, Attenuation, Photopic zone, Zones, Hy-

The Secchi disk is a circular white disk that is lowered into a natural body of water by a human observer until it disappears from view. The depth of disappearance is a visual measure of the clarity of the water. This review examines the physical and physiological basis of the Secchi disk procedure. The theory of the white disk is detailed to show the underlying assumptions and the consequent strengths and limitations of the procedure. The theory shows how to use a calibrated Secchi disk to predict illuminance levels as a function of depth. In particular it is shown how to predict the euphotic depth of a medium. Ten laws of the Secchi disk are stated verbally and in mathematical form. The laws show how variations in properties of the disk and the surrounding light field affect the depth of disappearance of the disk. Theory and examples lead to the following three main conclusions: (i) the Secchi disk reading zeta sub SD (in meters) yields a quantitative estimate of a single preparate certain property (albha 4, K) (ner meter) meters) yields a quantitative estimate of a sin apparent optical property (alpha + K) (per me

RESOURCES DATA—Field 7

Data Acquisition—Group 7B

of a natural hydrosol, where alpha is the (photopic) beam attenuation coefficient and K the (photopic) diffuse attenuation coefficient of the medium; (ii) the primary function of a Secchi disk is to provide a simple visual index of water clarity via zeta sub SD or alpha + K; (iii) to extend the use of the Secchi disk by auxiliary objective electronic measurements of alpha or of K, or both, is to risk obviating or abusing this primary function. (Author's abstract) W87-04425

ELECTRONIC FLOWMETER FOR IRRIGA-TION WATER BASED ON A PLATE ORIFICE (N ELEKTRONIESE DEURSTROMINGS-METER VIR BESPROEIINGSWATER, GEBA-SEER OP 'N PLAATMONDSTUD', Stellenbosch Univ. (South Africa). Dept. of Engi-

neering. W. P. J. Wessels, and W. H. Steyn. Water S. A. WASADV, Vol. 12, No. 3, p 161-166, July 1986. 2 fig, 1 tab, 6 ref.

Descriptors: *Flowmeters, *Performance evalua-tion, *Irrigation water, *Measuring instruments, Computers, Automation, Irrigation systems.

An electronic water meter, developed for irriga-tion purposes, is described. It is based on an orifice plate in a pipe, a silicon differential pressure trans-ducer, and a micro-processor with automatic zero referencing. The meter is a self-contained unit which can be programmed to determine a limited number of statistical properties of the flow being measured. It can also communicate with an extermeasured. It can also communicate with an exter-nal computer. The accuracy of a prototype accord-ing to volumetric tests was found to be well within the expected accuracy of +/- 2%, with the flow rate varying over a range of 3.5 l/s to 35 l/s. A block diagram of the meter is included. (Author's abstract)

PROGRAM AND PERFORMANCE CHARACTERISTICS OF THE ENVIRONMENTAL CHAMBERS DURING A LONG-TERM EXPERIMENT WITH NORWAY SPRUCE TREES EXPOSED TO OZONE, ACID MIST, AND FROST (BESCHREIBUNG DER EXPOSITIONSKAMMERN UND DER VERSUCHSEEDINGUNGEN BEI DER BELASTUNG VON PFLANZEN MIT LUFTSCHADSTOFFEN UND KLIMASTRESS, Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Lehrstuhl füer Bodenkunde.
H. D. Payer, C. Bosch, L. W. Blank, T. Eisenmann, and K. H. Runkel.
Forstwissenschaftliches Centralblatt, Vol. 105, No. 4, p 207-218, September 1986. 6 fig., 13 ref.

Descriptors: "Climate simulation, "Spruce trees, "Ozone, "Acid fog, "Acid rain, "Air pollution effects, "Environmental chambers, "Acid fog, Air pollution, Climatic stress, Bavaria, Plant pathology, Hydrogen ion concentration, Water pollution effects.

effects.

The climatic and pollutant conditions simulated in the new environmental chambers of the OSF (Gesellschaft fuer Strahlenforschung) during the course of the first (five-month) experiment are described. The equipment consists of four subchambers within a single environmental chamber, permitting different pollutant levels in each subchamber while maintaining a uniform climate for all. Each subchamber contains twelve four-year-old clonal Norway spruces. This so-called pilot project was also used to assess the technical performance of this new research facility during realistic experimental conditions. The factorial design with 16 groups analyzed the effects of normal winter temperatures vs. an episode of severe frost, low vs. elevated ozone concentrations, misting with water of pH 5.6 vs. water of pH 3.0, and fertilized vs. unfertilized soil. The climatic conditions and ozone levels applied were based on long-term field measurements from the higher regions of the Bavarian forest. The main characteristics of this exposure program are outlined and an assessment of the technical performance of the chambers is given. Although the climate chamber can not

function as a meteorologically accurate simulation of total climate it can usefully simulate the effects of individual factors relevant to a given species (e.g., ozone). (Airone-PTT) W87-04488

ATTEMPTING FLOW FORECASTS OF THE INDUS RIVER, PAKISTAN, USING REMOTE-LY SENSED SNOW COVER DATA, Waterloo Univ. (Ontario). For primary bibliographic entry see Field 2E. W87-04555

DYNAMIC CALIBRATION OF TIPPING BUCKET RAINGAUGES,
Lund Univ. (Sweden). Dept. of Water Resources

Engineering.
J. Niemczynowicz.
Nordic Hydrology NOHYBB, Vol. 17, No. 3, p 203-214, 1986. 8 fig. 5 tab, 4 ref.

Descriptors: *Computers, *Data processing, *Calibrations, *Rain gages, *Measuring instruments, *Rainfall, Precipitation, Performance evaluation,

Since most data are processed in the computer, field data collection should be in a computer compatible form. Tipping bucket raingages produce rainfall data in digital form which can be readily rainfall data in digital form which can be readily processed by computers. The volume of water which tips the bucket is not a constant, but a function of rainfall intensity, the calculation of which is usually performed by an empirical, non linear calibration function. The dynamic calibration of three types of tipping bucket raingages extensively used in the Nordic countries was performed. The tested and calibrated gages were the LTH gage, the PLUMATIC gage, and the RIMCO gage. The procedure involved in the dynamic calibration of the tipping bucket raingages is described. Examples of typical calibration curves are provided. The magnitude of errors, in respect of measured rainfall intensity, which occur when linear gage calibration is used is also stated. (Author's abstract)

TIME-DOMAIN REFLECTOMETRY METHOD FOR MEASURING SOIL WATER CONTENT

AND SALINITY, AND SALINITY, Agricultural Research Service, Riverside, CA. Sa-linity Lab. For primary bibliographic entry see Field 2G. W87-04595

ANALYSIS FOR TRACE AMOUNTS OF GEOS-MIN IN WATER AND FISH, Agricultural Research Service, New Orleans, LA. Southern Regional Research Center. For primary bibliographic entry see Field 5A. W87.0460

FIELD TESTING OF A LARGE VOLUME LIQUID-LIQUID EXTRACTION DEVICE FOR HALOGENATED ORGANICS IN NATURAL

MATURAL WATERS, NATURAL WATERS, NATURAL NATIONAL Water Research Inst., Burlington (Ontario). Environmental Contaminants Div. For primary bibliographic entry see Field 5A. W87-04619

SIMPLE DEVICE FOR ISOLATION OF OR-GANIC COMPOUNDS FROM WATER, Gdansk Technical Univ. (Poland). Inst. of Inor-ganic Chemistry and Technology. For primary bibliographic entry see Field 5A. W87-04621

HEADSPACE EQUILIBRATION TECHNIQUE FOR MEASUREMENT OF DISSOLVED GASES IN SEDIMENT PORE WATER, Maryland Univ., Solomons. Chesapeake Biological

For primary bibliographic entry see Field 2H. W87-04629

HANDLING OF ENVIRONMENTAL AND BIO-LOGICAL SAMPLES VIA PRE-COLUMN TECHNOLOGIES, Vrije Univ., Amsterdam (Netherlands). Dept. of Analytical Chemistry. R. W. Frei, M. W. F. Nielen, and U. A. T.

International Journal of Environmental Analytical Chemistry IJEAA9, Vol. 25, No. 1-3, p 3-35, 1986.

Descriptors: *Water analysis, *Sample preparation, *Measuring instruments, *Pollutant identification, *Chromatography, *Analytical chemistry, *Automation, Extraction, HPLC, Adsorption, Ion exchange, Computers, Sampling, Sample preservations

Sample handling is still a weak point in chromatog-raphy and in analytical chemistry in general. One consideration is the automation potential of new procedures. Solid-liquid extraction techniques in consideration is the automation potential of new procedures. Solid-liquid extraction techniques in combination with pre-column technology are particularly promising in this regards. The construction and geometry of pre-columns both for conventional and narrow-bore HPLC are of major importance, since band broadening should be kept at a minimum for an optimal functioning of the analytical system. The various operations that can be carried out with such a pre-column are trace-enrichment, clean-up of the sample which depends on the type of adsorbents used in the precolumn, i.e. polar or apolar materials, ion exchangers or metal covered surfaces, etc., protection of the analytical column, field sampling and storage of samples and as a substrate for on-column chemical derivatizations. These various operations are demonstrated with practical examples from the fields of environmental and biological analysis. The selectivity can be further enhanced by coupling precolumn technology with selective detection modes such as diode array UV, electrochemical or fluorescence detection. This enables the construction of optimal and integrated analysis systems which are fully automated and microprocessor controlled. They can also be made compatible with miniaturized LC-technology. (Author's abstract) W87-04635

GAS FILTER RADIOMETER FOR CARBON MONOXIDE MEASUREMENTS DURING THE 1979 SUMMER MONSOON EXPERIMENT

(MONEX), National Aeronautics and Space Administration, Hampton, VA. Langley Research Center. For primary bibliographic entry see Field 5A. W87-04684

OPTIMIZED RETRIEVALS OF PRECIPITA-BLE WATER FIELDS FROM COMBINATIONS

BLE WATER FIELDS FROM COMBINATIONS OF VAS SATELLITE AND CONVENTIONAL SURFACE OBSERVATIONS, National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center. For primary bibliographic entry see Field 2B. W87-04687.

ATMOSPHERIC MEASUREMENTS OF NI-TROGEN DIOXIDE WITH A SENSITIVE LU-

MINOL INSTRUMENT, Unisearch Associates, Inc., Concord (Ontario). H. I. Schiff, G. I. Mackay, C. Castledine, G. W.

Harris, and Q. Tran.
Water, Air and Soil Pollution WAPLAC, Vol. 30,
No. 1/2, p 105-114, September 1986. 8 fig, 4 ref.

Descriptors: "Measuring instruments, "Acid rain, "Air pollution, "Pollutant identification, "Chemiluminescence, "Nitrogen dioxide, "Nitrates, Field tests, Urban areas, Rural areas, Photochemistry, Transport, Spectral analysis, Temperature, Monitoring.

The measurement of NO2 in air is of paramount importance for a number of reasons. Its presence in the atmosphere, whether from natural or human sources, initiates atmospheric chemistry. NO2 is the only gas in the troposphere which can be photodisociated by sunlight to produce O3. A highly sensitive, lightweight, portable instrument

Field 7—RESOURCES DATA

Group 7B-Data Acquisition

was developed for continuous monitoring of NO2 in air. It operates by detecting the chemiluminescence produced when NO2 encounters a surface wetted with a specially formulated solution containing luminol. Unlike other chemiluminescent instruments it measures NO2 directly and does not require prior conversion of NO2 to NO. It does not respond to H2O2, NO, HNO3, NH3, CO, CO2, SO2, or organic nitrates. The only interferences encountered to date are from O3 and PAN with the response to O3 being less than 0.2% of its response to NO2. The response time of the instrument is less than 1 s and its sensitivity is better than 5 pptv. The instrument shows a negative temperature dependence of about 2% /C degree which is compensated electronically. Measurements were made with the instrument during a number of field missions in polluted urban and relatively clean rural air. The relative influences of photochemistry and transport from local sources was observed. rural air. The relative influences of photochemistry and transport from local sources was observed. Simultaneous measurements made with this instrument and the unequivocal tunable diode laser adsorption spectroscopy method have shown excellent agreement. (Alexander-PTT) W87-04701

IDENTIFYING HYDRO RESOURCES WITH ENHANCED SATELLITE IMAGERY, Watermeyer, Legge, Piesold and Uhlmann, Ash-ford (England). M. Cambridge, J. McMahon Moore, and A. A.

International Water Power and Dam Construction IWPCDM, Vol. 38, No. 10, p 13-17, October 1986.

Descriptors: *Satellite technology, *Remote sensing, *Resources development, *Landsat, *Aerial photography, *Topographic maps, *Geologic maps, Hydroelectric power, Multi-spectral scanners, Rock types, Remote terrain, Planning.

Landsat multi-spectral scanner (mss) imagery in photographic form was used, in conjunction with available topographic and geologic maps, during the preliminary planning studies of potential dam sites in the Ula Jelai River basin, peninsular Malaysia. The Imperial College prototype analogue image processing system was used to provide color composite and edge-enhanced images for drainage, geological fold, fault, and joint trace (tectonic fabric) mapping and to provide information on rock type distribution at scales between 12250,000 and 1250,000. Remotely sensed space imagery, enhanced by analogue (optical) techniques, is a cheap, convenient, and useful supplement to existing geologic and topographic maps for preliminary regional site assessment in remote terrain. (Author's abstract)

WATER METERS AND METERING - THE STATE OF THE ART AND FUTURE DEVEL-For primary bibliographic entry see Field 5F. W87-04786

MEASURING SEWER SAG, South Stickney Sanitary District, Burbank, IL. S. Chatterjee, and F. DeCarlo. Operations Forum, Vol. 3, No. 11, p 17-18, November 1986.

Descriptors: *Sewer sag, *Pipeline sag, *Measuring instruments, *Remote sensing, *Cost analysis, *Sewer maintenance, *Pipes, Illinois, Inclinometer, Sludge.

The South Stickney Sanitary District, Burbank, IL, has been using the Sewer Sag Detector developed by AES Corporation to find sagging infrastructures that require immediate rehabilitation. An inclinometer with a distance measuring line attached is used to provide a detailed and quantitative profile of a sewer system, showing specific areas and dimensions of sewer sag and sludge deposits in an existing line. It is estimated that the inclinometer will cost \$7,000 or less when in mass production. It can be operated inexpensively and simply be collection system personnel, without ex-

tensive training. A television inspection system could cost \$80,000 and requires high operating and maintenance expenditures, may provide insufficient information on sag, and fails to indicate areas of excessive aludge deposits. (Rochester-PTT) W87-04805

GAS CHROMATOGRAPHY DETECTORS BASED ON CHEMILUMINESCENCE, Sievers Research, Inc., Boulder, CO. R. S. Hutte, R. E. Sievers, and J. W. Birks. Journal of Chromatographic Science JCHSBZ, Vol. 24, No. 11, p 499-505, November 1986. 3 fig, 1 tab, 36 ref, append. NSF Grant ISI 8521288.

Descriptors: *Measuring instruments, *Sample preparation, *Pollutant identification, *Oas chromatography, *Chemical analysis, Nitric oxide, Ozone, Thermal energy analysis, Nitric oxide, Ozone, Thermal energy analyser, Nitrogen, Sulfur, Hydrogen fluoride, Sulfur dioxide, Ammonia, Sludge,

The development of chemiluminescence (CL) detectors for gas chromatographic (GC) analysis is reviewed. CL detectors can be used to detect small amounts of reactive analytes in the presence of much greater concentrations of other species, thus reducing or eliminating sample preparation or fractionation prior to GC analysis. CL detectors are generally more expensive than standard GC detectors and hazardous gases are often used as reagents or are formed in the CL reaction. The sometimes large post-column dead volume of the CL reaction chamber can introduce band broadening and limit the use of capillary columns. The most widely used CL detectors for GC are based on the nitric oxide reacts with the use of capinary columns. In emois whely used to CL detectors for GC are based on the nitric oxide/ozone reaction. When nitric oxide reacts with ozone, only a small fraction of the nitrogen dioxide formed is in an electrically excited state. The first GC detector using this reaction was the thermal energy analyzer (TEA). The redox CL detector (RCD) can detect a wide range of compounds regardless of whether they contain nitrogen. In the sulfur-eelective detector, reduced sulfur compounds react with F2 to form vibrationally excited hydrogen flouride and other species. A GC CL detector for reduced sulfur compounds has also been developed based on the chemiluminescent reaction with ozone to form electrically excited sulfur dioxide. Applications of CL detectors for GC analysis include measurement of amonois and determination of nitro-aromatics in sludge. (Michael-PTT)

DETERMINATION OF ORGANIC FORMS OF MERCURY AND ARSENIC IN WATER AND ATMOSPHERIC SAMPLES BY GAS CHROMA-TOGRAPHY-ATOMIC ABSORPTION, Toronto Univ. (Ontario). Inst. for Environmental

Studies.

A. Paudyn, and J. C. Van Loon.
Fresenius' Zeitschrift fuer Analytische Chemie ZACFAU, Vol. 325, No. 4 p 369-376, October 1986. 6 fig, 6 tab, 14 ref. Ontario Ministry of Environment Project No. 140.

Descriptors: *Sample preparation, *Water analysis, *Measuring instruments, *Pollutant identification, *Analytical methods, *Gas chromatography, *Atomic absorption spectrophotometry, Dimethylmercury, Methylmercury, Ethylmercury, Dimethylarsine, Methylarsine, Ontario, Humber River, Detection limits.

A 45 centimeter column packed with Tenax was used to separate and determine the methylated mercury species dimethylmercury, methylmercury and ethylmercury and the methylated arsenic species dimethylarsine and methylarsine. All compounds were first extracted from waters and snow by a benzene-toluene mixture, evaporated if necessary and analyzed by gas chromatography with atomic absorption spectrometry as a detector. The dectection limits of this procedure were: four nanograms Hg in dimethylmercury and methylmercury, five nanograms Hg in ethylmercury and 25 nanograms As in dimethyl and methyl arsine in one liter of water. Methylmercury and ethylmercury

were detected in Ontario natural waters and snow at 12-45 and 7-15 nanograms mercury per liter respectively. The level of methylarsine varied from 40 to 90 nanograms per liter. Dimethylmercury and dimethylarsine were detected only in the Humber River. (Author's abstract)

INDUSTRIAL ANALYZER BY A POTENTIO-METRIC METHOD FOR TOTAL ORGANIC CARBON IN WATER, Compagnie Generale des Eaux, Paris (France). G. Randon, M. Dutang, R. Rosset, M. Caude, and

International Journal of Environmental Analytical Chemistry IJEAA9, Vol. 20, No. 1, p 1-12, 1985. 4 fig, 1 tab, 1 ref.

Descriptors: *Water analysis, *Sample preparation, *Potentiometers, *Organic carbon, *Measuring instruments, *Autoanalyzers, Oxidation, Carbon dioxide, Electrodes, Microprocessors, Monitoring, Calibrations, Mathematical equations, Photochemical oxidation, Ultraviolet radiation, Calibrations, Detection limits.

An industrial analyzer based on photochemical oxidation of organic substances present in water and on the measurement of released carbon dioxide by zero current potentiometry from a carbon dioxide sensitive electrode was developed. All appartus functions were monitored by a microprocessor. A nonfiltered water sample was taken at regular intervals and the inorganic carbon was eliminated by adding phosphoric acid and bubbling with compressed filtered air. Percoxdisulfate was introduced and ultraviolet irradiation was carried out. Refrigeration of the sample was retarded so that oxidation could occur at a greater than ambient temperature. Oxidation efficiency was close to 100% even for amino compounds which are more difficult to oxidize. Calibrations were performed using the standard addition method and an automatic electrode response monitoring procedure with calibrated hydrogenocarbonate solutions was perfected. Analysis time was 30 minutes and the apparatus demonstrated a two-week autonomy. Measurement ranges were 0-20, 0-400 and 0-2000 parts per million. Results obtained in the 0-20 parts per million. Results obtained in the 0-20 parts per million. Results obtained in the 0-20 parts per million range match laboratory measurements carried out with a Dohrmann 80 analyzer. (Author's abstract) W87-04882

ECONOMICS OF REMOTE METER READ-ING, Northern Illinois Water Corp., Champaign. For primary bibliographic entry see Field 5F. W87-04906

ESTUARINE AREAS OF PERNAMBUCO (AREAS ESTUARINAS DE PERNAMBUCO), Universidade Federal de Pernambuco, Recife (Brazil). Dept. de Oceanografia.
Por primary bibliographic entry see Field 2L. W87-04916

ORIFICE PLATES FOR FURROW FLOW MEASUREMENT: PART 1 - CALIBRATION, Agricultural Research Service, Kimberly, ID.
Snake River Conservation Research Center.
For primary bibliographic entry see Field 3F.
W87-04919

ORIFICE PLATES FOR FURROW FLOW MEASUREMENT: PART II - DESIGN AND

FIELD USE, Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center. For primary bibliographic entry see Field 3F. W87-04920

EFFECTS OF ENHANCED INITIAL MOIS-TURE FIELDS ON SIMULATED RAINFALL OVER WEST AFRICA AND THE EAST ATLAN-TIC,

Pennsylvania State Univ., University Park. Dept. of Meteorology.

Evaluation, Processing and Publication—Group 7C

For primary bibliographic entry see Field 2B. W87-04973

FRONTOGENESIS AND SYMMETRIC STA-BILITY IN A MAJOR NEW ENGLAND SNOW-For primary bibliographic entry see Field 2C. W87-04974

SOME COMMENTS ON PASSIVE MICRO-WAVE MEASUREMENT OF RAIN, National Aeronautics and Space Administration, Greenbelt, MD. Goddard Space Flight Center. T. T. Wilheit.

Bulletin of the American Meteorological Society BAMIAT, Vol. 67, No. 10, p 1226-1232, October 1986. 6 fig, 9 ref.

Descriptors: *Measuring instruments, *Remote sensing, *Rain, *Microwaves, *Microwave radiation, *Rain measurements, Radiation, Space, Precipitation, Estimating, Weather, Hydrometeors, Attenuation, Satellite technology.

Attenuation, Satellite technology.

It is argued that because microwave radiation interacts much more strongly with hydrometeors than with cloud particles, microwave measurements from space offer a significant chance of making global precipitation estimates. Over oceans, passive microwave measurements that can be very closely related to the rain rate independently of the details of the drop-size distribution. Over land, scattering of microwave radiation by the hydrometeors, especially in the ice phase, can be used to estimate rainfall. In scattering, the details of the drop-size distribution are very important and it is therefore more difficult to achieve a high degree of accuracy. The SSM/I (Special Sensor Microwave Imager), a passive microwave imaging sensor that will be launched soon, will have dual-polarized channels at 85.5 GHz that will be very sensitive to scattering by frozen hydrometeors. Other sensors being considered for the future space missions would extend our ability to estimate rain rates from space. The ideal spaceborn precipitation-measurement system would use the complementary strengths of passive microwave, radar, and visible/infrared measurements. (Author's abstract)
W87-04975 stract) W87-04975

FLOW, THE KEY MEASUREMENT, R. H. Babcock. Water Engineering and Management WENMD2, Vol. 133, No. 11, p 11, November 1986.

Descriptors: *Flow, *Flow measurement, *Water treatment, *Measuring instruments, *Wastewater treatment, Water supply, Flowmeters, Rate meters.

Measurement of flow is important in water and wastewater facilities since it is the basis for all plant accounting procedures, chemical feed selection rates and performance evaluation. Various devices for the measurement of flow were mentioned and their applications and limitations were discussed briefly. It was recommended that selection of the proper flowmeter be given careful consideration based on familiarity with both the specific project application and the variety of flowmeter types available. (Wood-PTT) W87-04977 Measurement of flow is important in water and

CONDUCTIVITY-TEMPERATURE STAND-ARDIZATION AND DISSOLVED SOLIDS ES-TIMATION IN A MEROMICTIC SALINE

TIMATION IN A MEROMICTIC SALINE LAKE, British Columbia Univ., Vancouver. Westwater Research Centre. For primary bibliographic entry see Field 5A. W87-05051

CHARACTERIZATION OF FRACTURE PER-MEABILITY WITH HIGH-RESOLUTION VER-TICAL FLOW MEASUREMENTS DURING BOREHOLE PUMPING, Geological Survey, Denver, CO. Borehole Geo-

physics Project. For primary bibliographic entry see Field 4B. W87-05065

AIRBORNE GEOPHYSICAL EXPLORATION FOR GROUND WATER,
Peterson, Grant and Watson Ltd., Toronto (Ontar-

io).

N. R. Paterson, and R. A. Bosschart.

Ground Water GRWAAP, Vol. 25, No. 1, p 41-50,

January-February 1987. 10 fig, 7 ref.

Descriptors: *Groundwater detection, *Ground-water potential, *Airborne exploration, *Measur-ing instruments, *Remote sensing, *Aquifers, *Ge-ological mapping, Data processing, Data interpre-tation, Electrical resistivity, Electromagnetic pro-specting, Regional surveys, Exploration, Mapping, Geolhydrology, Africa, Kenya, Burkina Faso, Cost

Ground water is becoming an increasingly important resource. It is estimated that some 1,500 million people worldwide do not have access to potable water or sanitation. Geophysical methods have been used for many years to assist in hydrogeological exploration for ground water. For the direct detection of water-bearing formations, the electrical resistivity method has been effective but relatively slow and costly. More recently, surveys have been conducted successfully with electroragnetic prospecting apparatus developed primarily for the mineral industry. Such equipment has the advantages of greater speed and portability, improved subsurface resolution, and better potential discrimination of conductive aquifers. Electromagnetic methods also can be applied from moving platforms, including fixed-wing aircraft and helicopters. Detailed and regional surveys conducted in recent years for geological mapping and mineral exploration in Africa (Burkins Faso and Kenya) and elsewhere have revealed important information of the location water to the territory of the territories of the location water to the section of the secti in recent years for geological mapping and mineral exploration in Africa (Burkina Faso and Kenya) and elsewhere have revealed important information on the location and nature of water-bearing formations and structures. Simultaneous measurements of the magnetic field have been used also to map faults and dikes of potential ground-water significance. New, wide-band, digital airborne equipment and processing systems are capable of carrying out rapid, inexpensive studies of subsurface formations to depths of at least 200 meters. Computerized interpretation techniques can produce maps of depth and electrical conductance of a variety of buried aquifers. Using these methods, exploration scheme is proposed that would involve the following phases: preliminary study, airborne survey and interpretation, drilling and testing, and ground geophysical and hydrogeological studies. It is estimated that such a program would cost U.S. \$100 to U.S. \$500/sq km. (Alexander-PTT) der-PTT) W87-05066

ABANDONED WELLS - HOW TO FIND THEM, National Water Well Association, Worthington,

For primary bibliographic entry see Field 5B. W87-05087

SUMMARY AND COMPARISONS OF THREE TECHNOLOGIES FOR LOCATING ABANDONED WELLS IN CENTRAL OKLAHOMA, Environmental Photographic Interpretation Center, Warrenton, VA.
For primary bibliographic entry see Field 5B.
W87-05088

USE OF ELECTROMAGNETIC INDUCTION FOR LOCATING SUBSURFACE SALINE MA-

FOR LOCATIVE SOLUTION TERIAL,
Commonwealth Scientific and Industrial Research
Organization, Canberra (Australia). Div. of Water
and Land Resources.
For primary bibliographic entry see Field 2G.
W87-05117

GEOCHEMICAL AND GEOPHYSICAL STUD-IES OF SALT WATER INTRUSION IN COAST-AL REGIONS,

Andhra Univ., Waltair (India). Dept. of Geophys-For primary bibliographic entry see Field 2L. W87-05119

ELECTROMAGNETIC MEASUREMENTS FOR SUBSURFACE HYDROCARBON INVESTIGA-

TIONS, Camp, Dresser and McKee, Inc., Annandale, VA. For primary bibliographic entry see Field 5B. W87-05149

7C. Evaluation, Processing and Publication

EXPERIMENTAL MONTHLY LONG-RANGE FORECASTS FOR THE UNITED KINGDOM: PART I. DESCRIPTION OF THE FORECASTING SYSTEM,

Meteorological Office, Bracknell (England). For primary bibliographic entry see Field 2B. W87-04374

FRICTION SLOPE AVERAGING IN BACKWA-TER CALCULATIONS,

Monash Univ., Clayton (Australia). Dept. of Civil Engineering. For primary bibliographic entry see Field 2E. W87-04390

MODIFIED STRONGLY IMPLICIT PROCE-DURE FOR GROUNDWATER FLOW ANALY-

SIS, Indian Inst. of Science, Bangalore. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.

ESTIMATION PROCEDURES FOR THE TYPE-1 EXTREME VALUE DISTRIBUTION, Colorado State Univ., Fort Collins, Dept. of Civil

Engineering. J. A. Raynal, and J. D. Salas. Journal of Hydrology JHYDA7, Vol. 87, No. 3/4, p 315-336, October 30, 1986. 9 tab, 28 ref.

Descriptors: *Estimating equations, *Comparison studies, *Data interpretation, *Extreme Value Type-1 distribution, *Gumbel distribution, *Statistical methods, *Mathematical studies, Mathematical analysis, Mathematical equations, Probability weighted moments method, Least squares method.

Six estimation methods for the Extreme Value Type-1 (Gumbel) distribution were analyzed and compared by using data generation techniques. Considering criteria of bias, variance and mean square error of estimates of parameters and quantile points, including ease of obtaining estimators, it was concluded that the best linear combination of order statistics compared favorably with the other methods for sample sizes smaller than 20. For larger samples the probability weighted moments method was preferred. Likewise, considering all factors of comparison, the least squares and mode-interquartile range methods should not be used for fitting the Gumbel distribution. (Author's abstract) W87-04402

VOLUMETRIC APPROACH TO NON-DARCY FLOW IN CONFINED AQUIFERS, Technical Univ. of Istanbul (Turkey). Dept. of Hydraulics and Water Power. For primary bibliographic entry see Field 2F. W87-04403

FREQUENCY ANALYSIS OF LOW FLOWS: HYPOTHETICAL DISTRIBUTION METHODS AND A PHYSICALLY BASED APPROACH, Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2E.
W87-04533

Group 7C-Evaluation, Processing and Publication

SIMPLE MODEL FOR SPATIAL-TEMPORAL PROCESSES, Stanford Univ., CA. Dept. of Statistics. For primary bibliographic entry see Field 2A.

FINITE ELEMENT ANALYSIS OF ARCH DAMS ON A PERSONAL COMPUTER, Beck (R.W.) and Associates, Seattle, WA. R. Stevenson, D. E. Bowes, and J. P. Radochia. International Water Power and Dam Construction IWPCDM, Vol. 38, No. 12, p 19-22, December 1986 7 fig. A ref.

Descriptors: *Model studies, *Computer programs, *Dam design, *Computers, *Arch dams, *ADSAS, *Model testing, *ANSYS-PC/LINEAR, Design standards, Dams, Mathematical studies, Dam foundations, Performance evaluation.

studies, Dam foundations, Performance evaluation. In the past, computerized structural analysis of concrete arch dams in the United States has usually been done using either the SAP IV finite element method (f.e.m.) or using the Bureau of Reclamation's trial load method computer program, ADSAS. The effectiveness of both these analytical methods has been verified on several occasions by model testing and comparison with actual structural behavioral results of arch dams. Both programs, however, require large main frame computers which can be costly and inconvenient for the designer who may not have direct access at his office to the necessary hardware. A well documented and supported finite element method program that had the capability of running on both the larger mainframe computers as well as smaller personal computers was selected for a comparison with the more traditional mainframe arch dam analysis program ADSAS. A new subset of a popular mainframe finite element computer program is now available for use on a personal computer. The application of the structural program package to the finite element analysis of concrete arch dams is discussed and results with the trial load method of analysis are compared. The ANSYS-PC/LINEAR f.e.m. computer program, which operates on the BM PC/XT, PC/AT or other IBM PC compatif.e.m. computer program, which operates on the IBM PC/XT, PC/AT, or other IBM PC compatible microcomputers, was the most economical and accurate program tested. The development of a mesh generator similar to the one used in the program ADAP is recommended to increase the f.e.m.'s arch dam model capabilities. (Alexander-PTT) W87-05014

ANALYSIS OF LONG-TERM ECOLOGICAL DATA USING CATEGORICAL TIME SERIES REGRESSION. Martin Marietta Environmental Systems, Colum-

bia, MD. For primary bibliographic entry see Field 8I. W87-05049

COMPUTERIZED DATA EVALUATION/MAN-AGEMENT FOR HYDROGEOLOGIC INVESTI-GATIONS, Shell Oil Co., Houston, TX.

Shell Oil Co., Mouston, 2.A.
C. C. Stanley.
The Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 28-37, 2 tab.

Descriptors: *Data processing, *Data evaluation, *Geohydrology, *Computers, *Groundwater pollution, Automation, Database management, Management techniques, Computer programs.

Vast amounts of data are generated at groundwater contamination sites. Computerized hydrogeologic data evaluation and management can be accomplished using various techniques. Spreadsheet programs are utilized to enter data and automatically perform calculations. In addition, it is possible to incorporate spreadsheet data into database management programs. Specialty programs are capable of performing enhanced data analyses such as: (1) well/aquifer hydraulic evaluation, (2) con-

touring, (3) cross section development, (4) ground-water/contaminant modeling, and (5) geophysical analyses. Many of these specialized programs, previously available only for large mainframe computers systems, have been reprogrammed to run on some of the more sophisticated personal computers. Project management can also be easily accomodated using several methods. Complicated investigations are effectively managed with programs which utilize critical path analyses or similar techniques. Multiproject programs can be managed through use of database management programs. Proper tailoring of computer systems (software/bardware) to fit individual requirements involves many considerations. Some major factors include: (1) Data evaluation/management requirements, (2) Software availability/development, and (3) Hardmany considerations. Some major factors include:
(1) Data evaluation/management requirements, (2)
Software availability/development, and (3) Hardware compatibility. Each of these factors is reviewed here, with an example which integrates many of the discussed techniques provided. (See also W87-05128) (Lantz-PTT)
W87.05131 W87-05131

DRASTIC: A STANDARDIZED SYSTEM TO EVALUATE GROUND WATER POLLUTION POTENTIAL USING HYDROGEOLOGIC SET-

National Water Well Association, Worthington,

OH.

L. Aller, J. H. Lehr, R. Petty, and C. T. Bennett.
IN: Petroleum Hydrocarbons and Organic Chemicals in Ground Water - Prevention, Detection and Restoration - A Conference and Exposition, Proceedings of the NWWA/API Conference, November 13-15, 1985, The Westin Galleria, Houston, Texas. 1986. p 38-57, 4 fig, 11 tab, 2 ref.

Descriptors: *Groundwater pollution, *Geohydrology, *DRASTIC, *Data evaluation, Water depth, Recharge, Aquifers, Aquifer media, Soil media, Topography, Vadose water, Permeability coefficient, Conductivity.

cient, Conductivity.

DRASTIC is a methodology which allows the pollution potential of any area to be systematically evaluated anywhere in the United States. The system optimizes the use of existing data and has two major portions: the designation of mappable units, termed hydrogeologic settings, and the superposition of a relative ranking system called DRASTIC. Hydrogeologic factor which are used to infer the potential for contaminants to enter groundwater. These factors form the acronym DRASTIC, and include depth to water, net recharge, aquifer media, soil media, topography, impact of the vadose zone and hydraulic conductivity of the aquifer. The relative ranking scheme uses a combination of weights and ratings to produce a numerical value, called the DRASTIC Index, which helps set priorities for areas with respect to pollution potential. (See also W87-05128) (Lantz-PTT)

INTERPRETATION OF GAS CHROMATOG-RAPHY DATA AS A TOOL IN SUBSURFACE HYDROCARBON INVESTIGATIONS, Amoco Corp., Tulsa, OK. For primary bibliographic entry see Field 5B. W87-45151

8. ENGINEERING WORKS

8A. Structures

FULL SPEED AHEAD: WATER RESOURCES BILL PUMPS MONEY AND ENERGY TO For primary bibliographic entry see Field 6E. W87-04372

HYDRAULIC DESIGN ALGORITHMS FOR PIPE NETWORKS, Kentucky Univ., Lexington. Dept. of Civil Engi-

For primary bibliographic entry see Field 5F. W87-04393

STRESS-STRAIN STATE OF THE SAYANO-SHUSHENSKOE DAM DURING FILLING OF

SHUSHENSKOE DAM DURING FILLING OF THE RESERVOIR, E. K. Aleksandrovskaya. Hydrotechnical Construction HYCOAR, Vol. 20, No. 3, p 123-129, March 1986. 5 fig, 4 ref. Translat-ed from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 5-10, March 1986.

Descriptors: *Stress analysis, *Sayano-Shushens-koe Dam, *Reservoirs, *Gravity dams, *Dams, Deformation, Rheology, Hydrostatic level, Con-crete dams, Cantilever stresses, USSR.

The results of monitoring by means of long-term on-site observations and inspections indicated that the gravity-arch dam was in satisfactory condition during its construction and simultaneous staged filling of the reservoir. The changes in the main parameters including deformations, stresses, seepage heads and discharges which characterize the static behavior of the structure were occurring in agreement with the changes in the hydrostatic load, temperature effects, and concreting, and grouting of the joints of the dam. Staged construction and loading of the dam substantially affected its stress-strain state. The incomplete dam was subjected to a constantly increasing hydrostatic load which led to a redistribution of arch and cantilever stresses, to a decrease of compressive stresses in the fourth column, and to an increase in the third. The actual values of the arch stresses in the first column of the dam at an elevation of the the first column of the dam at an elevation of the the first column of the dam at an elevation of the upper pool level close to 500m were commensurate with those calculated for the normal pool level. Temperature and moisture factors caused the compressive stresses on the upstream face to be larger than designed. As a result, the upstream face of the dam in past stages of filling was compressed practically over the entire height. (Wood-PTT) W87-04413

GROUNDWATER LOWERING IN THE FOUN-DATION PIT OF THE KAISIADORYS PUMPED-STORAGE STATION, V. A. Nepomnyashchii, L. A. Titov, and A. M.

Hydrotechnical Construction HYCOAR, Vol. 20, No. 3, p 130-135, March 1986. 4 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p

Descriptors: *Dewatering, *Groundwater levels, *Aquifers, *Foundation pits, *Kaisiadorys pumped-storage station, *Powerplants, Kaunas re-ervoir, Streva River, Confined aquifers, San-And aquifers, Silt, USSR, Water yield, Wells.

Sand aquifers, Silt, USSR, Water yield, Wells. The unified foundation pit of the powerhouse of the Kaisiadorys pumped-storage station and reverse canal is located on a cove of the Kaunas reservoir with an elevation of the normal pool level of 144m at the debouchment of the Streva River. It is located at the boundary of two hydrogeological subregions and the pit of the pumped-storage station penetrates four aquifers. The excavation for the powerhouse cuts through the Likhyin, Odintsovo, and alluvial aquifers of the Quaternary deposits and penetrates 12-13m into silt. The silt made the deterioration of the strength and deformation characteristics of the base sides of the pit a danger. The selection of the method of draining the silt was an especially important problem during the design of a system of 64 wells with submersible pumps. The low permeability of the silt, high anisotropy, and its insignificant water yield required the use of special groundwater lowering means able to vacuum the adjacent volumes of waterlogged soil. (Wood-PTT)

USE OF STRUCTURAL ANCHORS IN UNDER-GROUND HYDRAULIC STRUCTURES.

V. F. Ilyushin. Hydrotechnical Construction HYCOAR, Vol. 20, No. 3, p 135-143, March 1986. 8 fig, 6 ref. Translat-ed from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 14-19, March 1986

Descriptors: *Anchors, *Hydraulic structures, Entry portals, Water intakes, Spillway gates, Tun-

Structures—Group 8A

nels, Pressure conduits, Tunnel spillways, Crane track supports, Bar supports, Cantilever-bar supports, Beam-bar supports, Arch-bar supports.

Anchors are widely used as anchor supports and components of structural elements in mining and in underground hydrotechnical construction. In the first case the anchor support strengthens rocks in the contour zone around a structure and increases the stability of exposures during construction by reinforcing layers and structural blocks. In the second case, the rock is used as a medium in which structural anchors are fastened and operating loads are transmitted to them, using the bearing properties of the rock mass. Characteristic examples of the use of structural anchors in underground structures were examined. (Wood-PTT)

STRENGTH OF LIGHTLY REINFORCED ELE-OIREMAIN OF LIGHTLY REINFORCED ELE-MENTS IN A COMPRESSED ZONE WITH CONSIDERATION OF INELASTIC DEFORMA-TIONS OF CONCRETE, For primary bibliographic entry see Field 8F. W87-04419

VERTICAL DRAINAGE IN THE FOUNDA-TION OF THE OVERFLOW DAM OF THE DNEPRODZERZHINSK HYDROELECTRIC STATION.

SIAIUN, O. N. Nosova, and L. G. Egorova. Hydrotechnical Construction HYCOAR, Vol. 20, No. 3, p 175-180, March 1986. 6 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p

Descriptors: *Foundation rocks, *Vertical drainage, *Overflow dams, *Dneprodzerzhinsk hydroelectric station, *Hydroelectric plants, *Concrete, *Dams, *Seepage, Piezometric head, Seasonal deformations, USSR.

The concrete overflow dam of the Dneprodzerzhinsk hydroelectric station is located on a rock area of the right-bank floodplain composed of granite-gneisses. The dam is massive, gravity, of a flattened profile, with a submerged weir, and crest length of 191.5m. The seasonal variations of the discharge and piezometric heads observed on-site indicated the presence of seasonal deformations of the seepage medium, which with time could change the state of the contact zone of the dam foundation. The results of measuring the temperature of the seepage flow made it possible to distinguish weakened areas of the foundation subject to special monitoring and to estimate the degree of influence of the lower pool on the drainage discharge. According to an approximate evaluation, the inflow from the lower pool did not exceed 10% of the total discharge. The data of the temperature measurements confirmed the overall effectiveness of the vertical drainage system for discharge of the flow in the dam foundation. The wells of the vertical drainage system, accessible for measuring the discharge and water temperature and also for conducting experiments with tracers, could serve as a means of reliable monitoring of the state of the watertight and drainage devices in the foundations of concrete structures and could give additional valuable information about the development of seepage processes in the foundation of the structure. (Wood-PTT) opment of seepage processes in the foundation he structure. (Wood-PTT)

CALCULATION OF BUTTRESSES OF RE-

TAINING WALLS, V. M. Sokolov. Hydrotechnical Construction HYCOAR, Vol. 20, No. 3, p 189-192, March 1986. 2 fig. 4 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p

Descriptors: *Cracks, *Stress, *Buttresses, *Retaining walls, *Reinforcement bars, *Concretes, Horizontal reinforcement bars, *Crtical reinforcement bars, Diagonal reinforcement bars, Mathe-

Calculation of buttresses of retaining walls is insufficiently elucidated in the technical and education-

al literature. Therefore, the calculation of a butall literature. Therefore, the calculation of a but-tress reinforced by horizontal, vertical, and diago-nal reinforcement bars was examined. Equations were derived and a sample calculation shown. Horizontal and vertical reinforcements were deter-mined first and then calculations of a buttress with respect to the normal and diagonal sections with the assumption of the formation of cracks in the concrete. After formation of cracks, the reinfor-ing hars bound the concrete into a sincle whole concrete. After formation of cracks, the reinforcing bars bound the concrete into a single whole. The stresses in the bars of different directions intersecting the crack on its length were related to the size of the opening of the crack. The maximum stresses, limited by the design resistance of the reinforcement, occurred in the bars near the back face of the buttress, and in other vertical and horizontal bars which intersected the crack the stresses decreased proportionally in the direction toward the compressed zone of concrete, where they vanished. (Wood-PTT)

CONSIDERATION OF MOISTURE EFFECTS ON THE UPSTREAM FACE OF CONCRETE DAMS, I. B. Sokolov, and V. A. Rasskazchikov.

1. B. SOKOIOV, and V. A. Rasskazemkov. Hydrotechnical Construction HYCOAR, Vol. 20, No. 3, p 193-198, March 1986. 3 fig. 7 ref. Translat-ed from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 54-57, March 1986.

Descriptors: "Moisture effects, "Concrete dams, "Dams, "Stress, "Moisture stress, "Concretes, Sayano-Shushenskoe dam, Reservoirs, Krasnoyarsk dam, Zeya dam, USSR.

Because several factors affect the work of a dam, it has not been possible to isolate and estimate quantitatively moisture-induced stresses and there was an absence of data on the change in the moisture content of concrete in structures. Investigations of the saturation of concrete of the Sayano-Shushense dam showed that during five years of operation of the structure, moisture penetrated into the concrete to a depth of 4-6m, and the maximum change in the moisture content of the concrete of the upstream face was 1.5%. The moisture induced strains at a denth of 0.5m from the unstream face the upstream face was 1.5%. The moisture induced strains at a depth of 0.5m from the upstream face reached a value of 0.000045-0.000053 and at a distance of 4.5-5m a value of 0.000006-0.00001. The change both in the depth of penetration of moisture into the structure and in the degree of saturation occurred most intensely during the first 1-15 years after a rise of the head. Calculation of moisture induced stresses on the basis of data from onsite investigations showed that compressive stresses, which reached 0.95-1.52 MPa, occurred on the upstream face of the dam. The width of the zone of compression was 3-4m for concrete located below the seasonal drawdown of the reservoir and up to 2m in the zone of the variable waterlevel. A generalization of the results of investigating saturation of concrete in the zone of the upstream face of tion of concrete in the zone of the upstream face of the Sayano-Shushenskoe dam and also of the addiuse Sayano-Sausnenskoe dam and also of the additional data obtained at the Krasnoyarsk and Zeya dams made it possible to establish a general regularity for determining stresses occurring on the upstream face of dams of various types due to swelling of concrete. (Wood-PTT)

HYDRODYNAMIC PRESSURES ON DAMS WITH NONVERTICAL UPSTREAM FACE, Universidad Autonoma de Puebla (Mexico). Es-

Omversidad Autonoma de Fueda (Mexico). Escuela de Ingenieria Civil.

J. Aviles, and F. J. Sanchez-Sesma.
Journal of Engineering Mechanics (ASCE)
JENMDT, Vol. 112, No. 10, p 1054-1061, October 1986. 5 fig. 7 ref.

Descriptors: "Mathematical equation, "Numerical analysis, "Dams, "Hydrodynamics, "Upstream, Downstream, Headwaters, Treffz-Mikhlin method, Hydrology, Fluid mechanics, Flow characteristics, Barriers, Check structures, Dikes, Leveee, Com-

An analytical solution, using the Treffz-Mikhlin method, was used to present seismic-induced hydrodynamic pressures on dams with a nonvertical upstream face. The solution was built as a linear

combination of functions which satisfy all boundary conditions except the one at the upstream face of the dam. The unknown coefficients of the linear form were obtained from the continuous treatment of the remaining boundary condition in the least-squares sense. Numerical results were presented for different geometries of the dam-water interface, and comparisons with exact and experimental solutions are provided. In general, the present solutions was considered a fair agreement with exact and numerical ones. On the other hand, some doubts were raised on experimental results obtained more than thirty years ago. It is believed that those procedures led to some errors. This does not mean that experiments are not appropriate to deal with the problem. More reliable experimental techniques can be used in conjunction with analytical and numerical solutions to each our experimental techniques can be used in conjunction with analytical niques can be used in conjunction with analytical and numerical solutions to solve more complicated problems. (Author's abstract) W87-04523

HYDRAULIC FRACTURING IN EMBANK-MENT DAMS, J. L. Sherard.

Journal of Geotechnical Engineering (ASCE) JGENDZ, Vol. 112, No. 10, p 905-927, October 1986. 6 fig, 27 ref.

Descriptors: *Seepage, *Leakage, *Dams, *Embankments, *Hydraulic fracturing, Hydrology, Barriers, Check structures, Dikes, Earthworks.

Sufficient evidence exists to conclude that concer Sufficient evidence exists to conclude that concentrated leaks occur commonly through the impervious sections of embankment dams by hydraulic fracturing without being observed, even in dams without unusually large differential settlement. Usually these concentrated leaks do not cause enter the property of the valority is too. Journal Usually these concentrated leaks do not cause ero-sion, either because the velocity is too low or because the leak discharges into an effective filter. Subsequently the leakage channels closed by swell-ing or softening of the embankment material form-ing the walls of the crack. In the typical case no measurable leakage emerges downstream and there is no other indication that a concentrated leak developed and was subsequently sealed. This action probably occurs to some degree in most embankment dams. (Author's abstract)

DETERMINATION OF THE PARAMETERS OF DISTURBED ZONES WHEN DESIGNING THE SUPPORT OF UNDERGROUND HY-

THE SUPPORT OF UNDERGROUND HYDRAULIC STRUCTURES,
N. S. Chetyrkin, V. I. Sheinin, E. F. Rikkert, V.
M. Benenson, and M. G. Bikineev.
Hydrotechnical Construction HYCOAR, Vol. 20,
No. 5, p 253-257, May 1986. 2 fig, 2 tab, 7 ref.
Translated from Gidrotekhnicheskoe Stroitel'stvo,
No. 5, p 1-4, May 1986.

Descriptors: *Disturbed zones, *Structure supports, *Tunnel construction, *Tunnel linings, *Rockslides, *Rock properties, *Design methods, Statistics, Soviet Union, Prediction, Probabilistic

Methods of designing the linings and temporary supports for underground structures having a transport, hydraulic, or industrial purpose in rocks of average or above average strength are discussed, with particular emphasis on the method of determining the dimensions of disturbed zones that was developed at the N. M. Gersevanov Scientific-Research Institute of Bases and Underground Structures (NIIGSP). The outlines of rock falls obtained were used by the State Special Design Institute and NIIGSP when they calculated the loads on the temporary in-situ concrete support of a highway tunnel of the Irganai hydro development and diversion tunnels of the Rogun hydroelectric station. The developed statistical probability approach permits predicting the load on the support related to the possibility of the formation of a rock fall (if not determined by a joint system) in relation to the depth of the given section of the to a rock tail (in not determined by a joint system) in relation to the depth of the given section of the tunnel and calculated reliability. Compared with the method of determining the load according to M. M. Protod'yakonov's 'arching' hypothesis, the present method permits a more flexible and substantiated (depending on the depth and necessary

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reliability) approach to the design of supports, thereby producing more economical and reliable designs. (Author's abstract)

ORGANIZATION OF CONCRETING AT THE

ORGANIZATION OF CUNCRETING AT THE WATER INTAKE OF THE KAISIADORYS PUMPED-STORAGE STATION, V. N. Mekhed'kin. Hydrotechnical Construction HYCOAR, Vol. 20, No. 5, p 252-260, May 1986. 3 fig. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 4-6,

Descriptors: *Concreting, *Intakes, *Construction. *Pumped storage, *Cost analysis, *Management planning, *Personnel management, Lithuanian-SSR, Scheduling, Information.

The procedures for concreting the water intake at the Kaisiadorys pumped-storage station in Lithuanian-SSR are described, including crane arrangements, placing of concrete, personnel management, and project management documents. The use of the watch method of organizing personnel (7-day watches, 12-hr shifts each day) made it possible to stabilize the crew and to provide rest conditions for the workers. The collection of information materials (CIM), which is a description of the structure and progress charts, considerably reduced labor expenditures of engineers and technicians, control apparatus departments, and industrial-technical makeup administrations when performing future and current planning and drawing up orders for construction materials and articles, and work performance graphs. The CIM also permits conducting component-by-component checking of the works. (Rochester-PTT)

EXPERIMENTAL TESTS OF THE STRESS STATE OF THE METAL PIPE ON THE DNEPR-DONBASS CANAL, V. F. Kanarskii, P. D. Gavrish, S. I. Karlin, N. I. Ostrikov, and V. A. Shul'ga. Hydrotechnical Construction HYCOAR, Vol. 20, No. 5, p 261-265, May 1986. 4 fig. 1 tab, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 5, p 6-9, May 1986.

Descriptors: *Conduits, *Canals, *Construction, *Pipelines, *Metal pipes, *Stress analysis, *Backfill, Soil physics, Dnepr-Donbass canal, Soviet Unism.

Experimental and analytical studies were conducted of the stress state of 2020/15-mm metal pipes as a result of soil load from backfilling to substantiate and develop the technology of performing earthworks during laying of the main water conduit for the Dnepr-Donbass Canal (USSR). The main conduit is being laid mainly in loam soils with a 1.5-5 m of fill above the top of the pipe. The conduit is about 120 m long. The present studies made it possible to lay the pipes of the conduit without compaction of the backfill for a distance of about 100 km and without placing a sand bed under the pipes for a distance of about 50 km. (Rochester-PTT)

CONCERNING THE PROBLEM OF SEISMIC STABILITY OF THE NUREK DAM, SIABILITY OF THE NUMER DAM,
O. A. Savinov, P. L. Ivanov, N. D. Krasnikov, A.
L. Mozhevitinov, and M. F. Skladnev.
Hydrotechnical Construction HYCOAR, Vol. 20,
No. 5, p 278-285, May 1986. 1 fig. 2 tab, 5 ref.
Translated from Gidrotekhnicheskoe Stroitel'stvo,

No. 5, p. 18-23, 1986

Descriptors: *Nurek Dam, *Earth dams, *Earth-quake engineering, *Dam stability, Soviet Union, Shear strength, Dam construction, Reinforced con-

The method employed by previous workers who concluded that earthquake resistance of the Nurek earth dam (USSR) was inadequate is questioned and examples of dams from around the world are listed to support the view that reinforcement of the

dam with antiseismic collars is not needed. The design and layout of reinforced concrete antiseismic collars for Nurek dam also are discussed. It is concluded that investigations and calculations performed by many agencies have shown that seismic stability of Nurek dam (in an intensity 9 earthquake zone) is sufficient without installation of antiseismic collars. The conclusions of insufficient seismic stability of this dam result from an unjustified overestimation of the calculated seismic actions used for its design, considerable underestimation of the design characteristics of the shearing resistance (strength) of its materials, and use of simplified methods of calculating its seismic stability. Adding reinforced-concrete antiseismic collars leads to a substantial inhomogeneity of the reinforced zone of the structure, which under intense seismic actions could lead to a worsening of the functioning of this zone of the structure. (Rochester-PTT) W87-04769

LAND RECLAMATION HYDRAULIC STRUC-

Z. Y. Yaroslavskii, and E. S. Lepnova. Hydrotechnical Construction HYCOAR, Vol. 20, No. 5, p 286-291, May 1986. 4 fig. 15 ref. Translat-ed from Gidroteckhnicheskoe Stroitel'stvo, No. 5, p 29-32, May 1986.

Descriptors: "Hydraulic structures, "Land reclamation, "Water management, Exhibition, Water-proofing, Superplasticizers, Soviet union, Chanel excavation, Canal linings, Spillways, Conduits, Earth dams, Dam construction, Overflow dams, Energy dissipators, Agriculture, Foundations.

New developments in hydrotechnical construction being exhibited as part of the 'Land Reclamation and Water Management' portion of the 'Science Aiding Industry' exhibit are described. These in-clude the following: sluice offtake regulators with an increased conveyance capacity on canals and small rivers, which have swinging wing walls at-tached to the walls of the culvert chamber; a new small rivers, which have swinging wing walls attached to the walls of the culvert chamber; a new design of water intake structures for mountain rivers; epoxy compositions for waterproofing of hydraulic structures in Siberia (superplasticizers INKhP-4 and INKhP-11), a 'self-erosion' method of forming the channels of large canals, an intake suitable for draining surface water from cultivated fields without interfering with farm machinery, constructing lined canals with the ETTs-151 excavator, revetment of reclamation canals by a porous concrete wall, an automatic siphon regulator for the lower pool of pipe structures on small streams, high-head spillways of two designs, a method of obtaining filter materials of high quality for constructing earth dams, regulation of backwater on overflow dams, energy dissipators in the lower pool of water conduits on fine-sand foundations, soft linings for canals and water bodies, a method and device for determining shrinkage of clays, manuals for preparation of foundations on slumping soils, and a method of compacting slumping soils by hydraulic vibration. (Rochester-PTT)

LOW-HEAD HYDRO ON THE AUSTRIAN

DANUBE, Oesterreichische Donaukraftwerke A.G., Vienna. G. Wedam, and P. Gruss. International Water Power and Dam Construction IWPCDM, Vol. 38, No. 11, p 13-16, November 1986. 3 fig. 1 tab, 4 ref.

Descriptors: *Danube, *Hydroelectric plants, *Energy, *Financing, *Quality control, *Turbines, Austria, Turbines, Generators, Ecology, Greifenstein power scheme, Water management.

In the past 30 yr, eight multipurpose run-of-river plants with 20 vertical and 45 bulb-type Kaplan units have been constructed and operated on the plants with 20 vertical and 45 bulb-type Kaplan units have been constructed and operated on the Danube. These facilities are discussed in terms of selection of power units, investment costs, energy production, operations, engineering studies, generator stability, quality assurance, and ecology. Comprehensive investigations for the 293 MW Greifenstein power scheme on the Austrian Danube led to following general conclusions: considerable costs can be saved by installing bulb units; addi-

tional output capacity can be obtained by optimiz-ing hydraulic characteristics; high on-grid stability can be achieved by an advanced generator design; operating reliability can be ensured by comprehen-sive quality assurance; and environmental impact can be managed and controlled Water managed. operating remaining can be ensured by comprehen-sive quality assurance; and environmental impact can be managed and controlled. Water manage-ment practices and civil works for restoring the depleted water table in the wooded floodplain between Altenworth to Korneuburg are described.

DESIGNING HYDRO RESERVOIRS TO PRE-VENT TROPICAL DISEASES, Blue Nile Associates, Foxboro, MA. W. R. Jobin.

W. R. Jobin. International Water Power and Dam Construction IWPCDM, Vol. 38, No. 11, p 19-22, November 1986. 5 fig, 2 tab, 9 ref.

Descriptors: "Water pollution effects, "Pest control, Biocontrol, "Hydroelectric plants, "Reservoir design, "Reservoir operation, "Tropic zone, "Human diseases, "Animal diseases, Liver flukes, Cattle, Sheep, Malaria, Bilharzia, River blindres, Onchocerciasis, Mosquitoes, Snails, Africa, Central America, Orinoco River, South America, Tilapia, Fish, Somalia.

The characteristics of malaria, bilharzia, river bindness (onchocerciasis), and liver flukes of cattle and sheep are described and techniques for preventive design and operation of reservoirs to control these diseases are discussed. Mosquito and snail populations can be controlled by manipulating reservoir levels; proper design of spillways can limit the populations of the tropical blackfly, transmitter of river blindness in Africa and Central America; and design of reservoir shorelines can be focused on elimination of suitable habitats by including apid drainage systems. Diseases of cattle and sheep can be limited by controlling access of animals to the water with fencing. Biological control of the bilharzia snail has been accomplished by the introduction of Marsia, a larger snail from the Orinoco River area South America. The large snail outcompetes the bilharzia snail in reservoirs. The outcompetes the bilharzia snail in reservoirs. The Tilapia fish and two new species from Somalia have been used to control mosquito larvae. (Rochester-PTT) W87-04773

ENVIRONMENTAL IMPACT OF THE SANMEN GORGE PROJECT, Scientific and Technological Information Inst., Beijing (China).
For primary bibliographic entry see Field 6G. W87-04774

HYDRO AND THE ENVIRONMENT: EVALU-

ATING THE TRADEOFFS,
International Bank for Reconstruction and Development, Washington, DC.
For primary bibliographic entry see Field 6G.
W87-04775

BINATIONAL GABCIKOVO-NAGYMAROS

V. Lokvenc, and M. Szanto. International Water Power and Dam Construction IWPCDM, Vol. 38, No. 11, p 33-40, 55, November 1986. 7 fig. 10 tab.

Descriptors: "Hydroelectric plants, "International agreements, "Danube River, "Gabcikovo-Nahymaros project, "Construction, Czechoslovakia, Hungary, Locks, Dans, Dredging, Economics, Scheduling, Management planning.

The joint Czechoslovak-Hungarian Gabcikovo-Nagymaros hydro scheme, exploiting the waters of the Danube from Bratislava to Budapest is now under construction. The project is designed for flood protection, electric power production, and aiding navigation along the common Czechoslo-vak-Hungarian sector of the river. This project, which is designed to have a total installed capacity of 878 MW, is described here in terms of geogra-phy and characteristics of the river system, seismic

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zones, hydro plant design, the reservoir at Hrusov-Duns-kiliti, Dunskiliti weir, navigation locks, riv-erbed deepening, distribution of construction work and project ownership, main construction activities and requirements for materials, construction sched-ule, and economics. Work began on the scheme in 1978 and is now scheduled to continue through 1995 after adjustments in schedule due to economic constraints. (Rochester-PTT) W87-04776

IDENTIFYING HYDRO RESOURCES WITH ENHANCED SATELLITE IMAGERY, Watermeyer, Legge, Piesold and Uhlmann, Ash-ford (England). For primary bibliographic entry see Field 7B. W87-04779

FINAL STAGE OF GURI COMPLETED, Electrification del Caroni Ca., Caracas (Venezu-H. Roo G.

International Water Power and Dam Construction IWPCDM, Vol. 38, No. 10, p 18-21, October 1986.

Descriptors: *Hydroelectric plants, *Reservoirs, *Guri project, *Dam construction, Venezuela, Concrete dams, Caroni River.

The final stage of Venezuela's Guri project is now complete, and this year's flood season is filling the 363,000,000 cu m reservoir. By 8 November 1986, all 20 units will have been commissioned, providing an installed capacity of 10,000 MW and capable of producing 50,000 GWh/yr. The Guri I powerhouse was completed in 1978; the final stage just completed entailed raising the height of the concrete dam by 52 m. Powerhouse No. 2, spillway raising, and other aspects of the project, as well as other projects on the Lower and Upper Caroni River are described. (Rochester-PTT)

TRENDS IN THIRD WORLD HYDRO DEVEL-

International Water Power and Dam Construction IWPCDM, Vol. 38, No. 10, p 26-28, October 1986.

Descriptors: *Electric power demand, *Developing countries, *Hydroelectric power, *Financing, Industrial growth, China, India, Nepal, Pakistan.

Current (1982) electricity generating capacity and estimated small hydro potential for several countries in the Third World are summarized and problems associated with hydropower schemes are discussed. Financial troubles, in conjunction with various technical problems, have led to a serious decline in the reliability of many Third World power systems which, in turn, may impede industrial growth. Small hydro has considerable potential for providing decentralized power to rural areas. Many successes have been attained in this field, particularly in China, India, Nepal, and Pakistan, but small hydro continues to receive a small share of the funding devoted to power development. (Rochester-PTT)

PLANNING MODEL FOR OPTIMAL HYDRO PLANTING EXPANSION, Helsinki Univ. of Technology, Espoo (Finland). Control Engineering Lab. For primary bibliographic entry see Field 6A.

NEW SEWER IN ONE NIGHT: REPLACE-MENT WITHOUT EXCAVATION,

A. P. Brigham. Operations Forum, Vol. 3, No. 11, p 14-16, No-

Descriptors: *Sewer construction, *Sewer system *Insitutorm, *Pipes, *Public relations, *Rehabilitation, District of Columbia, Ohio, Pennsylvania,

Virginia, Maryland, Sewer districts, Construction,

On site reconstruction of sewers in the service area of the Washington (District of Columbia) Suburban Sanitary Commission, Cincinnati (Ohio), Lebanon and Marysville (Pennsylvania), Fort Belvoir (Virginia), and Baltimore (Maryland) is discussed, and the development and merits of this method are reviewed from a public relations standpoint. The technique requires no excavation, blockage of streets, or other disruptions typical in conventional sewer reconstruction. A television camera is used to inspect piping and locate defects, and cracks and breaks in laterals are sealed by injection. Air testing is possible within about 30 seconds of sealing. This method has received much positive media attention in the cities where it has been used. (Rochester-PIT) (Rochester-PTT)

MEASURING SEWER SAG, South Stickney Sanitary District, Burbank, IL. For primary bibliographic entry see Field 7B. W87-04804

OVERCOMING A SEWER MORATORIUM, For primary bibliographic entry see Field 5D. W87-04805

WATER POWER TAPS INTO HAZARDS, For primary bibliographic entry see Field 8H. W87-04830

BATTLING A RISING GREAT SALT LAKE, For primary bibliographic entry see Field 4A. W87-04837

DAM SAFETY AND THE COMPETENCE OF THE PROFESSION.

F. S. Lee. International Water Power and Dam Construction IWPCDM, Vol. 38, No. 12, p 15-16, December

Descriptors: *Dam safety, *Professional personnel, *Education, *Public policy, *Civil engineering, Dam failure, Dam design, *Training, Safety, Engineering, Construction, Dams.

Dam building technology and engineering and research needs to be updated and improved by (1) updating civil engineering curricula, particularly in water resources departments, (2) separating dam engineering educational and training programs from other civil engineering branches; and (3) implementing research on advanced techniques for evaluating dam safety. It is suggested that antional dam safety boards be established that would be responsible for certifying dam design engineers, dam safety inspectors and contractors. An independent national dam safety agency having only two branches: the engineering branch (technical) and the management branch (non-technical) is also proposed. The threat of dam failures to public safety is real and the responsibilities of those involved in dam safety should not be underestimated. Public confidence is essential in carrying out a nationwide dam safety program. It is concluded eu. ruone connoence is essential in carrying out a nationwide dam safety program. It is concluded that the civil engineering profession is in a unique position to bring together the technical and man-agement skills needed to implement an effective dam safety program. (Peters-PTT) W87-05012

AUSTRALIAN GUIDELINES ON DESIGN FLOODS FOR DAMS, B. Cantwell, and K. Murley. International Water Power and Dam Construction IWPCDM, Vol. 38, No. 12, p 16-19, December 1994 2 per 1994 2 pe

Descriptors: *Dam design, *Design floods, *Dams *Spillways, *Design standards, *Risk analysis *Economic aspects, Floods, Australia, Civil Engi-neering, Hazards.

The Australian National Committee on Large Dams (ANCOLD) has recently produced guidelines as a basis for reasonable, consistent practice, but with scope for engineering judgement. The need for them was identified from a survey of flood practices which showed wide variations between the various authorities in Australia. The guidelines include a concept of incremental flood hazard category with relevant recommended design floods, and a procedure for review of the adequacy of existing dam spillways with provision for economic risk analysis to determine the extent of upgrading. (Author's abstract)

FINITE ELEMENT ANALYSIS OF ARCH DAMS ON A PERSONAL COMPUTER, Beck (R.W.) and Associates, Seattle, WA. For primary bibliographic entry see Field 7C. W87-05014

SAFETY ASSESSMENT OF TWO CONCRETE

SAFETY ASSESSMENT OF TWO CONCRETE DAMS,
Motor-Columbus Ingenieurunternehmung A.G.,
Baden (Switzerland).
For primary bibliographic entry see Field 8F.
W87-05016

APPLICATION OF STATISTICAL METHODS IN MONITORING DAM BEHAVIOUR, Vorarlberger Illwerke A.G., Schruns (Austria). E. Purer, and N. Steiner. International Water Power and Dam Construction IWPCDM, Vol. 38, No. 12, p 33-35, December

Descriptors: *Statistical analysis, *Mathematical models, *Computer programs, *PROGNOSE, *Dam stability, Dams, Arch dams, Monitoring, Prediction, Comparison studies.

Monitoring the behavior of a dam is partially based on the analysis of the measurements taken from the instruments built into the dam body. Such an analysis is performed through comparing the recorded values to expected values, which were obtained using diverse influential factors, and then testing the actual values for their acceptability. The expected result and/or the predicted value, depending on whether the dam structure is still in a trial phase or has been in operation for some time. phase or has been in operation for some time, can be calculated with a deterministic model, using phase or has been in operation for some time, can be calculated with a deterministic model, using recorded values, experience and/or by applying a statistical or a hybrid model. Vorariberger Illwerke AG has developed two statistical models, the regressive model and the hybrid autoregressive model, to support dam behavior monitoring procedures. This was made possible by the availability of existing extensive measurement data. By applying the models, the prediction of the horizontal movements of various points on the 122 m-high Kops arch dam, which was constructed between 1962 and 1967, was performed. When the regressive model is applied, the storage level determines the variables influencing dam behavior. In the mixed autoregressive model, variables which represent previously recorded storage levels produce the most informative statement. The data were analyzed using the computer program PROGNOSE, which permits the development and correction of information covering the storage level, temperature, and displacement at one particular point. (Peters-PTT) W87-05017

ASSESSMENT OF RISK FOR A GRAVITY

ASSESSMENT OF RISA FOR A CARLOLD AM, British Columbia Univ., Vancouver. Dept. of Mechanical Engineering.
K. V. Bury, and H. Kreuzer.
International Water Power and Dam Construction IWPCDM, Vol. 38, No. 12, p 36-40, December 1986. 6 fig, 3 tab, 21 ref.

Descriptors: *Risk assessment, *Gravity dan *Dam failure, *Cost benefit analysis, *Dam desig *Design standards, Dams, Risks, Hazards, Instance, Economic aspects.

Field 8—ENGINEERING WORKS

Group 8A—Structures

From its definition, risk assessment appears simple. In practice, however, the cause of a possible failure is not an easily predictable, simple event, nor is the consequence of a failure event an easily predictable simple result. Failure causes are associated with uncertain events, the most crucial ones often with a chain of events. These events condition the likelihood of failure. Likewise, the magnitude of failure consequences tends to be mitigated by human actions that may be organized or improvised. These actions are also chains of uncertain events, such as hazard recognition, functioning of warning system and evacuation. The operation of a device or structure which may fail entails a risk which is defined as the product of the likelihood of failure and the magnitude of the consequences of failure. For as the product of the likelihood of failure and the magnitude of the consequences of failure. For dams, the purpose of risk assessment is twofold. First, to enable a cost/benefit analysis to be made of alternative actions, the benefit being a relative risk reduction; the alternative actions may include several proposals for modifying the existing dam or at the design stage a comparison of several configurations and/or dimensional details. Second, to rank existing dams; high-risk dams may then be chosen for further investigation and remedial works. The probabilities of failure of a gravity dam were calculated for the cause-to-failure event chains of two acenarios: persistent overtopping and an earthquake. The event trees show that for cases in which hazards develop over a reasonable timespan, significant improvements in safety are possible through operational organization. (Alexander-PTT)

PRACTICAL DISPOSAL WELL DESIGN FOR THE PREVENTION OF GROUND WATER CONTAMINATION, Davis (Ken E.) Associates, Houston, TX. For primary bibliographic entry see Field 5G.

TECHNOLOGICAL CONSIDERATIONS IN CLASS I INJECTION WELLS, Golden Strata Services, Inc., Houston, TX. For primary bibliographic entry see Field 5E. W87-05079

ABANDONED WATER WELLS IN SOUTH-EASTERN MINNESOTA, Minnesota Dept. of Natural Resources, St. Paul For primary bibliographic entry see Field 5B. W87-05089

8B. Hydraulics

NOMOGRAMS FOR CALCULATING PRI-MARY AND SECONDARY WAVE DIFFRAC-TION ON WATER AREAS OF PORTS AND

RESERVOIRS,
N. N. Zagryadakaya.
Hydrotechnical Construction HYCOAR, Vol. 20,
No. 3, p 144-151, March 1986. 7 fig. 3 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p

Descriptors: *Primary wave diffraction, *Hydrodynamics, *Secondary wave diffraction, *Ports, *Reservoirs, *Waves, *Nonograms, *Mathematical equations, Mathematical studies, Equations, Design standards, Inlets, Comparison studies.

Consideration of diffraction when selecting the optimal planar layout of ports according to standards was carried out by introducing diffraction coefficients calculated at various points of the water area to the heights of the initial waves: h sub dif = h(k sub dif) where h was the height of the initial wave at the inlet to the water area; h sub dif and k sub dif were respectively the height of the diffraction coefficient at a given calculated point. Nomograms were developed which allowed the determination of the values of the diffraction coefficients when the water area was protected by a breakwater, single moles, or convergent moles in the case of a frontal approach of the initial waves. Numerous calculations.

tions of the values of the diffraction coefficients k sub dif by means of computers were performed when compiling the nomograms. The satisfactory comparisons of the results obtained by the nomo-grams to experimental data allowed recommendagream to experimental data allowed recommenda-tion of the use of the nomograms developed for determining the primary diffraction coefficients and coefficients of reduction due to secondary diffraction for use in calculating wave heights on existing and planned water areas. (Wood-PTT) W87-04416

WAVES ON DISTORTED MODELS OF OUTER HARBORS, M. E. Plakida

Hydrotechnical Construction HYCOAR, Vol. 20, No. 3, p 152-154, March 1986. 1 fig, 5 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p ed from Gidrotekh 24-25, March 1986.

Descriptors: *Waves, *Mathematical models, *Outer harbors, *Hydrodynamics, *Distorted models, Wave turbulence, Wave height, Mathematical equations, Wavelengths, Reynolds number,

Investigations of wave regimes of water areas of outer harbors on a distorted model permitted increasing the wave turbulence, which is the main requirement for providing conversion of laboratory data to the prototype in wave investigations. The need for introducing corrections to the values of the residual wave height obtained on the model was determined by calculation or by measurement of the residual wave height to the prize to the total scale into consideration. The appropriate equations were derived. The use of a distorted model when investigating the wave regimes on the water area of an tigating the wave regimes on the water area of an outer harbor reduced the amount of work on creat-ing the model itself and on the time and cost of the tions. (Wood-PTT)

CHARACTERISTICS OF PRESSURE FLUCTU-ATIONS BEYOND SPILLWAYS WITH A LEDGE,

V. M. Ivanov, and M. M. Mukh No. 3, p 154-157, March 1986. 3 fig, 6 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p ed from Gidrotekh 26-28, March 1986.

Descriptors: *Model studies, Hydrodynamics, *Pressure fluctuations, *Spillways, *Dams, Overflow dams, Separation zones, Reverse flow, Revetment, Froude number, Mathematical equations, Reynolds number, Comparison studies.

Reynous number, Comparison studies.

In the lower pool of overflow dams there always occurs a markedly varying flow characterized by the presence of separation zones and increased dynamic effect of the flow on the structures bounding it. Between the through-going flow and region of reverse flow a layer of intense turbulent mixing forms with large velocity fluctuations causing considerable fluctuations of the free surface in the open flow. A preliminary comparison was made of the wave and turbulent components on the basis of the results of model investigations of pressure fluctuation on the channel revetment beyond an overflow dam with a ledge carried out at the Leningrad Polytechnic Institute. When calculating the pressure fluctuation intensity it was necessary to take into account that the dispersion of the turbulent component given by this calculation was commensurate with the dispersion of the of the turbulent component given by this calcula-tion was commensurate with the dispersion of the wave component of the pressure fluctuation, which could be determined from results of hydrauwhich could be determined from results of hydraulic investigations. Data obtained previously was used for estimating the intensity of the total value of pressure fluctuation on a revetment for a surface regime beyond a dam with a ledge under conditions of the two-dimensional problem and in the range of relative heights of the ledge d/h sub c = 3-5.5 and Froude numbers in the vena contracta on the ledge Fr sub c = 8-50. (Wood-PTT) W87-04418

HYDRODYNAMIC PRESSURES ON DAMS WITH NONVERTICAL UPSTREAM FACE,

Universidad Autonoma de Puebla (Mexico). Escuela de Ingenieria Civil. For primary bibliographic entry see Field 8A. W87-04523

HYDRAULIC FRACTURING IN EMBANK-MENT DAMS, For primary bibliographic entry see Field 8A. W87-04524

UNSTEADY SEDIMENT-TRANSPORT MOD-

California Inst. of Tech., Pasadena. Dept. of Environmental Health Engineering. D. A. Lyn. Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 1, p 1-15, January 1987. 5 fig, 19 ref. NSF Grant CEE79-20311 A02.

Descriptors: *Mathematical models, *Model stud-ies, *Sediment transport, *Sedimentation, *Mathe-matical equations, Boundary conditions, Deposi-tion, Dams, Sediments, Channels, Flow, Hydrau-lics, Alluvial channels, Sediment discharge.

Number of modeling of sediment transport in alluvial case also offers the possibility of routinely predicting sediment transport under very general flow conditions. The numerical sediment-transport problem has, however, been usually formulate exploit the availability of well-established sche originally developed for fixed-bed modeling. Such formulations tend to minimize the possible importance of a strong coupling between hydraulic sediment variables. The standard one-dimensi equations of unsteady sediment-transport are exam-ined, and multiple time (or length) scales are identi-fied. The existence of multiple scales may lead to a singularly perturbed behavior that should be taken into account in any general numerical model. Pre-vious models, which reduce the number of conser-vation equations solved simultaneously from three to two, are seen to be unable to satisfy exactly to two, are seen to be unable to satisfy exactly either a general boundary condition or a general initial condition. Implications for numerical modeling are explored. Numerical results for the model problem of sediment-deposition upstream of a dam illustrate the analytical argument. (See also W87-05021) (Alexander-PTT)

STABILITY OF A GENERAL PREISSMANN SCHEME

California Inst. of Tech., Pasadena. Dept. of Envi-ronmental Health Engineering. For primary bibliographic entry see Field 2J. W87-05021

DAM-BREACH FLOOD WAVE MODELS, Texas A and M Univ., College Station. Dept. of Civil Engineering. Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 1, p 29-46, January 1987.

Descriptors: *Dam breach, *Floods, *Unsteady flow, *Mathematical models, *Flood waves, Case studies, Surveys, Performance evaluation, Comparison studies, DAMBRK, SMPDBK, Computers,

Dam-breach flood wave analysis is a classic prob-lem of unsteady open-channel flow which has been of theoretical interest to hydraulic engineers for well over a century. Military concerns provided a major impetus for the development of practical dam-breach flood forecasting capabilities particu-larly during the 1940s and 1950s. An intensified public and governmental concern over dam safety has motivated a greatly increased civilian sector

larly during the 1998 public and governmental concern over dam safety has motivated a greatly increased civilian sector interest in dam-breach flood forecasting during the past decade. Recent dam safety programs being conducted by federal and state water resources development agencies and the flash flood warning program of the National Weather Service demonstrated a critical need for greatly expanded dambreach flood wave modeling capabilities. Generalized mathematical models have been and continue

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Hydraulic Machinery—Group 8C

to be developed to meet this need. A comparative evaluation of several leading models representative of the current state-of-the-art included a compreor the current state-of-the-art included a compre-hensive literature survey and application of the selected models to several case study data sets. A dynamic routing model should be used whenever obtaining a maximum practical level of accuracy is required and adequate manpower, time, and com-puter resources are available. The National Weathputer resources are available. The National Weather Service (NWS) Dam-Break Flood Forecasting Model (DAMBRK) is the optimal choice of model for most practical applications. Some applications require the capability to perform an analysis as expeditiously as possible. The NWS Simplified Dam-Break Flood Forecasting Model (SMPDBK) is the optimal choice of model for most of these types of amplications. (Alexander-PTT) types of applications. (Alexander-PTT) W87-05022

HYDRAULIC RESEARCH IN CHINA, Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China).

B. N. Lin, G. F. Li, and H. Q. Chen.
Journal of Hydraulic Engineering (ASCE)
JHENDB, Vol. 113, No. 1, p 47-60, January 1987.
7 fig, 1 tab, 61 ref.

Descriptors: *Hydraulic research, *Thermal powerplants, *Hydraulic machinery, *China, Cooling water, Sediment transport, River flow, Mathematical models, Effluents, Estuaries, Waves, Dam fail-

The last few decades have witnessed accelerated developments in hydraulics in China. These develdevelopments in hydraulics in China. These devel-opments were prompted by construction of large-scale hydraulic projects and thermal power plants. A brief account of these developments is given, covering such areas of specialization as sediment transport, high-velocity flow, river hydraulics, cooling of thermal effluents, hydraulic machinery, and hydraulic transients. In each case, selected references are given. Special attention is called to some strange flow phenomena at hyperconcentra-tions of sediment, innovations for the enhancement of energy dissipation, a new arrangement for the uous or seument, innovations for the enhancement of energy dissipation, a new arrangement for the intake structure for the cooling water of thermal power plants, and mathematical modeling of allu-vial rivers, with change in sediment composition taken into account. (Author's abstract) W87-05023

ANALYSIS OF NONLINEAR MUSKINGUM FLOOD ROUTING, Louisiana State Univ., Baton Rouge. Dept. of Civil For primary bibliographic entry see Field 2E. W87-05024

ANALYSIS OF BED-LOAD MOTION AT HIGH Queen's Univ., Kingston (Ontario). Dept. of Civil Engineering

eering.

Journal of Hydraulic Engineering (ASCE) JHEND8, Vol. 113, No. 1, p 97-103, January 1987. 1 fig. 9 ref.

Descriptors: *Bed load, *Shear stress, *Channels, *Conduits, *Flow, *Mathematical equations, *Numerical analysis, Shear, Stress, Solids, Boundary

In pressurized conduits and in well-developed bed-load motion in open channels, the shear stress is often large enough to set up a sheared layer several grain diameters in thickness. Experimental data show that the concentration of solids in the sheared layer decreases with height in an essential-ly linear fashion. This finding has already been used to calculate the velocity distribution within the sheared layer for the typical case where variaused to calculate the velocity distribution within the sheared layer for the typical case where variation of shear stress with height may be ignored; and this analysis has now been extended to obtain the solids discharge per unit breadth of bed. The result is in good agreement with the modified Meyer-Peter and Muller equation and with the writer's sand data, and provides an explanation of an apparent anomaly in the data obtained using 3.9 mm nylon particles. The new analysis also predicts

that the threshold-of-motion curve on the Shields diagram must approach a constant Upsilon-value at sufficiently small abscissae, a finding which appears to be in accord with recent experimental evidence. (Author's abstract) W87-05026

8C. Hydraulic Machinery

SMALL SCALE HYDROPOWER AND ANAD-ROMOUS FISH: LESSONS AND QUESTIONS FROM THE WINCHESTER DAM CONTRO-

VERSY, Lewis and Clark Coll., Portland, OR. Natural Re-For primary bibliographic entry see Field 6E. W87-04440

PUMPED-STORAGE STATIONS AND THE LIFE OF HYDROBIONTS, For primary bibliographic entry see Field 6G. W87-04767

LOW-HEAD HYDRO ON THE AUSTRIAN

DANUBE, Oesterreichische Donaukraftwerke A.G., Vienna. For primary bibliographic entry see Field 8A. W87-04771

MACHINERY AND EQUIPMENT FOR MICRO

HYDRO PLANTS, Intermediate Tech London (England). ology Development Group, R. Holland.

R. HOHARD. International Water Power and Dam Construction IWPCDM, Vol. 38, No. 11, p 17-19, November

Descriptors: *Hydroelectric plants, *Turbines, *Penstocks, *Developing countries, *Control equipment, Survey equipment, Cost analysis, Quality control, Pipes.

Criteria for selecting equipment for micro hydro plants for developing countries are surveyed. Turbines, control equipment, generators, penstock pipes, and survey equipment are considered. Equipment for micro hydro plants can vary widely in price and quality. It is important to select proven equipment at a price that is justified by the application. Local manufacture of simple turbines should always be considered if there is evidence as substantial market for micro hydro plants. With careful selection and engineering, micro hydro competes very well with diesel generators and extension of the grid. Cost and simplicity of operation are critical factors in choosing equipment. (Rochester-PTT)

DIMENSIONING VERTICAL LIFT GATES, Irrigation and Power Research Inst., Amritsar (India).

(India).
T. C. Paul, and G. S. Dhillon.
International Water Power and Dam Construction IWPCDM, Vol. 38, No. 11, p 45-47, November 1986. 6 fig, 11 ref.

Descriptors: *Lift gates, *Fixed-wheel gates, *Hydraulic machinery, *Hydraulic engineering, *Design criteria, *Model testing, Dimensioning, Performance failure.

Vertical-lift, fixed-wheel gates with skin plates, seals, and vertical lips on their upstream faces, may fail to close under their own weight if the length of the lip is not dimensioned correctly. Hydrodynamic forces on vertical-lift gates are analyzed, and results of experimental studies are described. The authors conclude that the design criterion for a vertical lip is different when the vertical-lift, fixed-wheel gate has its skin plate, seals, and lip on the upstream side than when these are on the downstream side. In the former case, extensive model tests should be undertaken to fix the length of the vertical lip. The value of projection of the skin plate/gate thickness should not exceed 0.45 and is

should not be < 0.42 to ensure closure of the gate. (Rochester-PTT) W87-04777

EMPIRICAL FORMULAE FOR GATE WEIGHTS,

WENDERS,
Northwestern College of Agriculture (China).
Y. He, and T. Huang.
International Water Power and Dam Construction
IWPCDM, Vol. 38, No. 11, p 52-55, November
1986. 2 fig, 2 tab, 9 ref, 2 append.

Descriptors: *Design standards, *Design equations, *Hydraulic equipment, *Roller gates, *Radial gates, China, Weights, Estimating, Equations.

Eight formulas for estimating the weights of gates used in water-supply, hydroelectric, or water transfer projects are given. Gates are steel lock gates (miter plane steel gates, lateral rolling steel gates, and vertical lift plain steel gates), hydraulic steel gates (submerged fixed-wheel steel gates and top-above-water radial steel gates), and reinforced concrete and wire fabric cement gates, top-above-water reinforced concrete and wire fabric cement gates, submerged plane reinforced concrete and wire fabric cement gates, and top-above-water radial reinforced concrete and wire fabric cement gates, and top-above-water radial reinforced concrete and wire fabric cement gates, and top-above-water radial reinforced concrete and wire fabric cement gates, and top-above-water radial reinforced concrete sand wire fabric cement gates, and top-above-water radial reinforced concrete sand wire fabric cement gates, and top-above-water radial reinforced concrete sand wire fabric cement gates, and top-above-water radial reinforced concrete sand wire fabric cement gates, and top-above-water radial reinforced concrete sand wire fabric cement gates, and top-above-water radial reinforced concrete and wire fabric cement gates, and top-above-water radial reinforced concrete sand wire fabric cement gates, and top-above-water radial reinforced concrete sand wire fabric cement gates, when the project concrete sand wire fabric cement gates, when the project gates are sand top-above-water radial reinforced concrete sand wire fabric cement gates, when the project gates are sand top-above-water radial reinforced concrete sand wire fabric cement gates, when the project gates are sand top-above-water radial reinforced concrete sand wire fabric cement gates, which gates are sand top-above-water radial reinforced concrete sand top-above-water radial reinforced concrete sand top-above-water radial reinforced concrete sand top-above-water radial top-above-water radial top-above-water radial sand top-above-water radial sand top-above-water radi the results compare favorably with published data on gates in other countries. (Rochester-PTT)

OPTIMAL SEQUENCING OF HYDROPOWER STATIONS, Berdal (A.B.) A/S, Sandvika (Norway).

A. J. Carlsen. International Water Power and Dam Construction IWPCDM, Vol. 38, No. 10, p 22-25, October 1986. 4 fig, 2 tab.

Descriptors: *Hydroelectric plants, *Optimization, *Mathematical models, *Cost analysis, Operations management, Norway, Electric power demand, Rufiji basin, Tanzania, Scheduling, Planning.

A Norwegian-developed method to identify the optimal form of development of hydropower projects, taking into account the effects of one project on another, is described. The model can include thermal power in the generation system, but is based on the assumption that hydropower is the dominant source of generation. Calculation of firm energy production and calculating the least-cost sequence that meets the demand for firm energy and power is described. As an example, the application of the method to the master plan of the Rufiji Basin (Tanzania) is presented. The optimal sequence for developing 17 projects over the period 1992-2032 was determined. (Rochester-PTT)

WATER METERS AND METERING - THE STATE OF THE ART AND FUTURE DEVEL-

For primary bibliographic entry see Field 5F. W87-04786

REHABILITATION OF WATERWELLS IN TU-NISIA (REGENERATION DE FORAGES EN TUNISIE), Deutsche Gesellschaft fuer Technische Zusam-menarbeit G.m.b.H., Eschborn (Germany, F.R.). For primary bibliographic entry see Field 3B. W87-

RECOMMENDATION FOR FLOOD DAMAGE REDUCTION AT WASTEWATER TREATMENT

squehanna River Basin Commission, Harrisburg, For primary bibliographic entry see Field 5D. W87-04807

TEST PROCEDURES FOR DETERMINING CAVITATION LIMITS IN CONTROL VALVES,

Field 8—ENGINEERING WORKS

Group 8C—Hydraulic Machinery

Utah Water Research Lab., Logan. For primary bibliographic entry see Field 5F. W87-04908

AUTOMATED SINGLE-PIPE IRRIGATION SYSTEM, Agricultural Research Service, Kimberly, ID. Snake River Conservation Research Center. For primary bibliographic entry see Field 3F. W\$7-04931

TEMPERATURE EFFECTS ON DRIP LINE

ARCHERATURE EFFECTS ON DRIP LINE HYDRAULICS, Chinese Academy of Agricultural Science, Henan. Research Inst. of Farm Irrigation. For primary bibliographic entry see Field 3F. W87-04934

WHAT TO LOOK FOR IN ARCHIMEDES SCREW LIFT PUMPS, CRS Sirrine, Inc., Chicago, IL. A. P. Flacet. Water Engineering and Management WENMD2, Vol. 133, No. 11, p 20-23, November 1986. 3 fig. 2

Descriptors: "Hydraulic machinery, "Hydraulic equipment, "Archimedes screw lift pumps, "Pumps, "Literature reviews, "Screw pumps, "Pump denign, Reviews, Design criteria.

Archimodes screw pumps are based on the very old principle in which a rotating shaft carrying a fixed spiral blade or flight in an inclined channel pushes a liquid to the top of a device. Literature was reviewed for information on the three basic types of screw pumps: the open flight screw pump, the tube mounted type, and the enclosed flight type. Data provided by the manufacturers was presented and basic design specifications were described. (Wood-PTT)

STATIC MIXERS BRING BENEFITS TO WATER/WASTEWATER OPERATIONS, Koch Bagineering Co., Inc., Wichita, KS. Static Mixing Group.
M. Mutsakis, and R. Rader.

Water Engineering and Management WENMD2, Vol. 133, No. 11, p 30-34, November 1986. 8 fig. 2

Descriptors: *Static mixers, *Wastewater treatment, *Water treatment, *Hydraulic machinery, *Mixing, Design criteris, Mixing quality, Rapid mixing, Flash mixing, Flocculation, Flocculent addition, Disinfection, Studge treatment, Hydrogen in concentration control.

son concentration control.

Static mixers can be used in water and wastewater treatment processes which require that controlled quantities of expensive additives in liquid, gaseous or solid form be mixed thoroughly into the main process stream in such operations as: pH control, flocculation, cosquilation, disinfection, filtration, or sludge treatment. Specific applications to these processes were discussed and a description of a static mixing unit and its advantages which include: no moving parts to wear or replace; energy requirements 1/10 to 1/100 that of dynamic agitation systems; in gravity flow, existing fluid head is adequate to accomplish most rapid/flash mixing task; mixing quality is controlled and predictable; low investment costs; retrofit is easy in existing pipes, sumps or rectangual r channels; small space requirements; chemical consumption is minimized; process performance and efficiency are maximized, were provided. (Wood-PTT)
W87-04983

DOUBLE LOOP CONTROL OF A HYDRO Illinois Univ. at Chicago Circle. Dept. of Energy Engineering.

Engineering.
C. K. Sanathanan.
International Water Power and Dam Construction IWPCDM, Vol. 38, No. 12, p 25-27, December 1986. 7 fg, 6 ref.

Descriptors: *Double loop controllers, *Hydraulic machinery, *Electrical equipment, *Controllers, *Turbines, Mathematical equations, Performance

Studies on the control of hydro turbine units have shown that a p.i.d controller can perform adequately; however, the controller parameters have to be tuned carefully, since the transient performance is often sensitive to both the system and the controller parameters. Limited success has been reported in enhancing the stability margins of the p.i.d. controller by incorporating some modifications to the basic scheme. A double loop scheme for the control of hydraulic turbo-generator units is presented; the inner control loop has a lead/lag controller, and the outer loop has a p.i. controller. The absence of a pure derivative term in the new controller and its double loop structure make it less sensitive to parameter variations as well as to noise. The robustness of the new control scheme is claimed to be superior to that of the conventional single loop p.i.d. control. (Alexander-PIT) W87-03015

TRENDS IN SELECTING AND PROCURING HYDRO TURBINES, Harza Engineering Co., Chicago, IL. R. W. Fazalare. International Water Power and Dam Construction IWPCDM, Vol. 38, No. 12, p 40-46, December 1986. 7 fig, 10 ref.

Descriptors: *Turbines, *Hydroelectric power, *Hydraulic turbines, *Hydraulic machinery, *Specifications, *Performance evaluation, *Maintenance, Vibration, Cavitation, Runners, Vanes.

tenance, Vibration, Cavitation, Runners, Vanes.

Certain hydraulic turbine characteristics related to long-standing operating problems with vibration, cavitation damage, transient pressures and speed are highlighted. The importance of plant availability, reduction in maintenance, and extension of the useful life of the machinery is emphasized. One of the most troublesome turbine characteristics is the forced vortex rotating core phenomenon which is the origin of draft tube pressure pulsations (DTPP). The frequency of the DTPP can be predicted based on the operating speed of the machine. Several intervention methods can be used to modify the frequency and/or amplitude of the DTPP. The remedy best suited for a particular design should be determined by modeling. Several model testing techniques, including Oil film trace, paint removal, and cavitation intensity tests should be used more extensively in the evaluation of cavitation. Procurement agreements should include provisions to perform these tests. Cavitation damage can often be traced to contour errors in the runner blade shapes, and poor surface finish. Improved manufacturing and quality control procedures are needed to eliminate these problems. It is suggested that future trends in the hydro industry are expected to demonstrate that the mitigation of these problems will overshadow further improvement of the peak efficiency of the hydraulic turbine. (Alexander-PTT)

HYDRAULIC RESEARCH IN CHINA, Institute of Water Conservancy and Hydroelectric Power Research, Beijing (China). For primary bibliographic entry see Field 8B. W87-05023

BENTHIC MACROFAUNAL PRODUCTION IN THE BAY OF FUNDY AND THE POSSIBLE EFFECTS OF A TIDAL POWER BARRAGE AT ECONOMY POINT - CAPE TENNY, Department of Fisheries and Oceans, St. Andrews (New Brunswick). (New Brunswick).
For primary bibliographic entry see Field 2L.
W87-05048

8D. Soil Mechanics

WAYS TO DEVELOP METHODS OF DETER-MINING PERMEABILITY OF NONSATURAT-ED SOILS,

V. N. Zhilenkov, V. V. Kayakin, A. I. Kotyuzhan, I. A. Parabuchev, and Y. S. Shevlyagin. Hydrotechnical Construction HYCOAR, Vol. 20, No. 3, p 181-188, March 1986. 7 fig. 5 ref. Translat-ed from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 48-52, March 1986

Descriptors: *Permeability, *Saturated soils, *Seepage, Rocks, Soils, Hydraulic structures, Calculations, Graphical methods, Field tests, Mathematical equations matical equati

matical equations.

During the design and construction of hydraulic structures it is often necessary to estimate the seepage properties of the earth materials of the foundation and abutments, which during surveys are unsaturated. Methods of estimating the seepage properties of saturated soils have been previously developed to a sufficient degree; for unsaturated materials a number of problems require special investigation. The authors concluded that calculation methods based on consideration of the number and size of water-conducting channels with consideration of the regularities established theoretically and experimentally could be used in preliminary stages to determine the impermeability of unsaturated soils to water in hydrotechnical construction. It was found to be advisable to use field methods for a more reliable evaluation. Air injection methods, which were described, were recommended for the results of air testing wells and pits was established theoretically and experimentally. (Wood-PTT) PTT) W87-04422

8E. Rock Mechanics and Geology

USE OF STRUCTURAL ANCHORS IN UNDER-GROUND HYDRAULIC STRUCTURES, For primary bibliographic entry see Field 8A. W87-04415

METHODS OF ESTIMATING THE DEGREE OF ANISOTROPY AND STRUCTURAL WEAK-ENING OF A JOINTED ROCK MASS, G. N. Kuzestov. Hydrotechnical Construction HYCOAR, Vol. 20, No. 3, p 166-174, March 1986. 3 fig. 4 tab, 7 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 33-39, March 1986.

Descriptors: *Anisotropy, *Structural weakening, *Rock mechanics, Structural engineering, Stratification, Cleavage, Jointing, Mohr circles, Vector

chagrams.

For an objective evaluation of the mechanical properties of rocks it is necessary to take into account the effect of the rock system of planes of weakness created by stratification, cleavage, and jointing of the rock mass. The effect of these factors is not usually revealed when testing small rock specimen under laboratory conditions, so a diagram of the ultimate Mohr circles was constructed, the envelope of which was called the 'technical certificate of strength' of the monolithic rock mass. In addition to this, specimen of rocks of the mass, including individual planes of weakness of the mass, including individual planes of weakness of the mass, were tested. A sample case was explained. All calculations and constructions for estimating the strength conditions of the mass and various conditions of its stress state could be carried out by means of the approximate generalized 'strength certificate' of the mass obtained. (Wood-PTT)

DETERMINATION OF THE PARAMETERS OF DISTURBED ZONES WHEN DESIGNING THE SUPPORT OF UNDERGROUND HY-DRAULIC STRUCTURES, For primary bibliographic entry see Field 8A. W87-04764

CONCERNING THE PROBLEM OF SEISMIC STABILITY OF THE NUREK DAM,

ENGINEERING WORKS—Field 8

Fisheries Engineering—Group 81

For primary bibliographic entry see Field 8A. W87-04769

For primary bibliographic entry see Field 8H. W87-04830 WATER POWER TAPS INTO HAZARDS,

MODEL TO EVALUATE THE TRANSIENT HYDRAULIC RESPONSE OF THREE-DIMENSIONAL SPARSELY FRACTURED ROCK MASSES,

MASSES, Pennsylvania State Univ., University Park. Dept. of Mineral Engineering. For primary bibliographic entry see Field 5B. W87-04945

EQUIVALENT CONTINUUM MODEL FOR COUPLED STRESS AND FLUID FLOW ANALYSIS IN JOINTED ROCK MASSES, Saitama Univ. (Japan). Dept. of Foundation Engi-

mary bibliographic entry see Field 2F.

8F. Concrete

STRENGTH OF LIGHTLY REINFORCED ELE-

STRENGTH OF LIGHTLY REINFORCED ELEMENTS IN A COMPRESSED ZONE WITH CONSIDERATION OF INELASTIC DEFORMATIONS OF CONCRETE, V. B. Nikolaev, S. Y. Gun, and S. E. Lisichkin. Hydrotechnical Construction HYCOAR, Vol. 20, No. 3, p 157-166, March 1986. 9 fig, 11 ref. Translated from Gidrotekhnicheskoe Stroitel'stvo, No. 3, p 28-33, March 1986.

Descriptors: *Concretes, *Inelastic deformations, *Cracks, *Design standards, *Reinforced concrete, Transverse reinforcement, Compressed zones, Block joints, Strength, Stress, Transverse tensile stress, Calculations.

stress, Calculations.

The causes of the unfavorable development of cracks in certain massive reinforced-concrete structural elements was investigated. Experimental procedures established that in reinforced-concrete structural elements with a certain percentage of reinforcement, in zones with structural transverse reinforcement under loads below the standard longitudinal extension, cracks of the compressed zone occur. This could lead to a decrease in the element's reliability, and in the presence of block joints in this zone, to a decrease of bearing capacity. The stress state of reinforced-concrete elements with cracks was investigated and it was established that the cause of longitudinal cracks was the presence of considerable secondary transverse tensile stresses in the zone of the vertex of the normal crack. A physical scheme explaining the occurrence of these stresses was presented. A convenient design method for determining the necessary transverse reinforcement usually installed for structural considerations was developed. Calculations showed that in many cases reducing the consumption of structural reinforcement was possible. (Wood-PTT)

CALCULATION OF BUTTRESSES OF RE-TAINING WALLS, For primary bibliographic entry see Field 8A. W87-04423

CONSIDERATION OF MOISTURE EFFECTS ON THE UPSTREAM FACE OF CONCRETE DAMS, ry bibliographic entry see Field 8A.

ORGANIZATION OF CONCRETING AT THE WATER INTAKE OF THE KAISIADORYS PUMPED-STORAGE STATION, For primary bibliographic entry see Field 8A. W87-04765

SAFETY ASSESSMENT OF TWO CONCRETE DAMS.

Motor-Columbus Ingenieurunternehmung A.G., Baden (Switzerland).

Battan (GWA)

R. Dungar.

International Water Power and Dam Construction IWPCDM, Vol. 38, No. 12, p 28-33, December 1986. 9 fig, 15 ref.

Descriptors: *Dam safety, *Risk assessment, *Concrete dams, *Computer programs, *Model studies, *Design standards, Numerical analysis, Gravity dams, Arch dams, Dams, Dam foundations, Stress, Creep, Materials, Construction.

Creep, Materials, Construction.

To design and maintain a concrete dam within a given margin of safety, it is necessary to satisfy certain constraints, or safety criteria. For example: (1) the dam and foundation must be resistant (to a given safety factor) against shear failure leading to the mechanically unstable condition of sliding; and, (2) stresses and strains must be kept within acceptable design limits related to concrete strength, to ensure that material integrity, and thus overall structural stability, is maintained. Assessments of dam safety have improved considerably with the availability of finite element computer codes. Two case histories are described. The design phase of the Paute Mazar gravity dam, sited in a narrow valley, was greatly influenced by results of a linear dynamic three-dimensional analysis; and the revaluation of the safety of the 27-year old Zervreila arch dam in Switerland has included non linear modelling of both the foundation and dam concrete including creep effects. (Alexander-PTT) W87-05016

8G. Materials

CUSHIONING STRESS AND STRAIN IN PIPE

SYSTEMS, Vibration Mountings and Controls, Inc., Bloomingdale, NJ.

Management WENMD2, Water Engineering and Management WENMD2, Vol. 133, No. 11, p 28-29, November 1986.

Descriptors: *Pipelines, *Pipes, *Water distribu-tion, *Pipe stress, *Rubber expansion joints, Leak-age, Flexible joints, Installation, Maintenance, High pressure, Thermal expansion, Thermal con-traction, Thermal stress, Stress, Vibration.

Stresses and strains caused by hydraulic surges, thermal expansions, thermal contractions, and persistent vibrations result in pipeline damage ranging from aggravating leaks at joints or flanges, to major pipeline ruptures that require expensive and lengthy service interruption and costly repair. Rubber expansion joints are recommended since they are lightweight, require little space, and are easy to install and maintain. The construction and applications of the standard types of rubber expansion joints were presented and installation and maintenance procedures were reviewed. (Wood-PTT) PTT) W87-04982

EPICHLOROHYDRIN IN SECONDARY CON-TAINMENT SYSTEMS, Carlisle SynTec Systems, PA. For primary bibliographic entry see Field 5G. W87-05075

TECHNOLOGICAL CONSIDERATIONS IN CLASS I INJECTION WELLS,
Golden Strata Services, Inc., Houston, TX.
For primary bibliographic entry see Field 5E.
W87-05079

NEW COMPOSITE LINER FOR HAZARDOUS WASTE IMPOUNDMENTS, Portland Cement Association, Skokie, IL. For primary bibliographic entry see Field 5E. W87-05097

LABORATORY EVALUATION OF SLURRY WALL MATERIALS OF CONSTRUCTION TO

PREVENT CONTAMINATION OF GROUND-WATER FROM ORGANIC CONSTITUENTS, Davis (Ken E.) Associates, Houston, TX. For primary bibliographic entry see Field 5G. W87-05098

8H. Rapid Excavation

WATER POWER TAPS INTO HAZARDS.

New Scientist NWSCAL, Vol. 112, No. 1530, p 44-47, October 16, 1986.

Descriptors: *Lake taps, *Rock excavation *Norway, *Lakes, *Tunnel hydraulics, *Hydro-electric plants, *Rockfill dams, Rock mechanics Slope stability, Glacial lakes.

Engineers in Norway have tapped about 500 lakes for hydroelectric power by tunneling under the lake bed and blasting through to release water. The Ulla-Forre hydroelectric project in southwest Norway includes 125 kilmeters of tunnel and more than 50 dams that link about 30 lakes and a large number of rivers. Eight lakes are joined to form a reservoir that is the ninth largest area of fresh water in Norway. The 19 subterranean lake taps that join the lakes are unique to Norway and one of the lakes contains the deepest known lake tap draining water from 108 meters below the surface. Unplugging a lake to make a tap is complex and dangerous. The tap allows water to flow out of the lake and down a tunnel to a turbine which drives a generator. At the end of each tunnel, a shaft rises at a steep angle to within a few meets of the lake Engineers in Norway have tapped about 500 lakes generator. At the end of each tunnel, a shaft rises at a steep angle to within a few meters of the lake ded. Continuous pumping maintains access to the shaft and its plug. The amount of explosive required to blast away each plug must be carefully determined. Lake taps can cause a rapid fall in the water level of a lake which, in turn, can cause pressure changes in the banks and result in landslides. The Kobsbelv lake tap project has encountered rockbust events that have created technical problems in the water and road tunnels and required replacement of the narrow-gauge railway that removes tunnel rubble. A new tunneling machine has been developed to address the problem of pitted walls, but drillers and demolition experts will have to continue tapping lakes and glaciers by hand. (Michael-PTT)

8I. Fisheries Engineering

SPAWNING MIGRATION OF GREAT LAKES PINK SALMON (ONCORHYNCHUS GORBUS-CHAI: SIZE AND SEX DISTRIBUTIONS, RIVER ENTRANCE AND EXIT, Department of Fisheries and Oceans, Sault Ste. Marie (Ontario). Great Lakes Fisheries Research Branch

For primary bibliographic entry see Field 2H. W87-04744

SPAWNING STOCK-RECRUITMENT RELA-TIONSHIPS AND ENVIRONMENTAL INFLU-ENCES ON THE TIGER PRAWN (PENAEUS ESCULENTUS) FISHERY IN EXMOUTH

ESCULENTUS PISHERY IN EXMOUTH GULF, WESTERN AUSTRALIA, Western Australian Marine Research Labs., Perth. J. W. Penn, and N. Caputi. Australian Journal of Marine and Freshwater Re-search AJMFA4, Vol. 37, No. 4, p 491-505, 1986. 7

Descriptors: "Spawning, "Fish stocks, "Recruitment, "Fisheries, "Tiger prawns, "Storms, "Fish populations, "Crustaceans, Cyclones, Rainfall, Regression analysis, Survival, Population dynamics, Fishing, Australia, Exmouth Gulf.

Although penaeid shrimp stocks support many important fisheries around the world little information is presently available on the fundamental relationships between spawning stock and recruitment for these species. In the absence of any clear stock-recruitment relationship (SRR) for penaeids in the literature, it has been generally assumed that any literature, it has been generally assume such relationship would be of an asymp

Field 8—ENGINEERING WORKS

Group 81—Fisheries Engineering

and that penaeid fisheries to date have operated at exploitation levels which maintained the stock in the flat section of the curve. A SRR between the spring spawning stock levels and the following autumn recruitment was established for P. esculen-tus in Exmouth Gulf. The basic SRR fits the data tus in Exmouth Gulf. The basic SRR fits the data well with the exception of 2 out of the 14 years when particularly severe cyclones occurred. This was taken into account by using multiple regression techniques to incorporate the amount of rainfall in January and February as variables representing indices of cyclone activity (multiple correlation of 0.97). An hypothesis for the observed positive and negative effects of cyclones on recruit survival was presented. The relationship between autumn recruitment and resultant spring spawning stock (RSR) later that year and the effects of fishing, measured in effective effort units, was also established (multiple correlation of 0.94). An examina-(ROSE) later the second of the interaction between the SRR and RSR relationships was reported which suggests that, under average environmental conditions and high levels of effort, recruitment will move towards a new lower equilibrium level. The robustness of the relationships with respect to assumptions involved and potential sources of bias in the variables used were evaluated and discussed. (Alexander-PTT) W87-05043

ANALYSIS OF LONG-TERM ECOLOGICAL DATA USING CATEGORICAL TIME SERIES REGRESSION, Martin Marietta Environmental Systems, Colum-

Martin Marietta Environmental Systems, Columbia, MD.
K. A. Rose, J. K. Summers, R. A. Cummins, and
D. G. Heimbuch.
Canadian Journal of Fisheries and Aquatic Sciences CIFSDX, Vol. 43, No. 12, p 2418-2426,
December 1986. 5 fig. 2 tab, 32 ref.

Descriptors: *Time series analysis, *Mathematical models, *Least squares method, *Fisheries, *Statistical analysis, *Population dynamics, Fish stocks, Delaware Bay, Delaware River, Dredging, Flow.

A time series method based on the use of categorized variables and ordinary least squares regression is proposed for the analysis of ecological data. It has several advantages over Box-Jenkins models and time series regression with continuous variables, including model specification based on ecological information regressions. and time series regression with continuous variables, including model specification based on ecological information, paraimonious representations of the functional forms of model terms and interactions, robust treatment of the high uncertainty associated with long-term ecological data, and interpretive features based on linear combinations of the regression coefficients. Aspects of model building, significance testing, and interpretation of results are discussed and illustrated with a fisheries example involving an annual measure of white perch (Morone samericana) stock size in the Delaware River/Bay from 1929 to 1974. Variation in white perch dynamics is analyzed using the following explanatory variables: lagged values of stock, hydrographic variables (freshwater flow and water temperature), and pollution-related variables (sæwage loading, dredging activity, and dissolved oxygen). Potential statistical problems with the new method involving multicollinearity, autocorrelated errors, and other violations of ordinary least squares are identified. (Alexander-PTT)

USE OF HATCHERY COHO SALMON (ON-CORHYNCHUS KISUTCH) PRESMOLTS TO REBUILD WILD POPULATIONS IN OREGON COASTAL STREAMS, Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife. T. E. Nickelson, M. F. Solazzi, and S. L. Johnson. Canadian Journal of Fisheries and Aquatic Sci-ences CIFSDX, Vol. 43, No. 12, p 2443-2449, December 1986. 4 fig. 3 tab, 17 ref.

Descriptors: *Population dynamics, *Coastal streams, *Salmon, *Presmolts, *Fish stocking, *Fish hatcheries, *Fish populations, Streams, Spawning, Reproduction, Population density,

The effectiveness of using hatchery coho salmon presmolts to rebuild wild populations in Oregon

coastal streams was evaluated. Juvenile and adult populations were monitored in 15 stocked and 15 unstocked streams from summer 1980 until summer 1985. During the summers following the planting of presmolts, the number of juveniles per square meter of pool surface area was higher in the stocked streams than in the unstocked streams. However, wild juveniles were significantly less abundant in the stocked streams during the 2 yr when density of wild juveniles was estimated separately from hatchery juveniles. Adult returns to the stocked streams were not significantly different from adult returns to the unstocked streams, but returns tended to be earlier in the stocked streams than in the unstocked streams. Despite similar numbers of adults per kilometer in the stocked streams and unstocked streams in the years the presmolts returned to spawn, the resulting densities of juveniles in the stocked streams were significantly lower than the densities of juveniles in the coastal streams was evaluated. Juvenile and adult cantly lower than the densities of juveniles in the unstocked streams. It is concluded that the early time of spawning of the hatchery coho salmon is largely responsible for their failure to rebuild the populations in the streams stocked with presmolts. populations in the (Author's abstract)

SEQUENTIAL TESTS FOR INFECTIOUS HE-MATOPOIETIC NECROSIS VIRUS IN INDI-VIDUALS AND POPULATIONS OF SOCKEYE SALMON (ONCORHYNCHUS NERKA), Seattle National Fishery Research Center, WA. For primary bibliographic entry see Field 5A. W87-05055

9. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

PREPARATION OF PROFESSIONALS FOR GROUNDWATER PROTECTION, California Univ., Los Angeles. R. L. Perrine.

The Environmental Professional, Vol. 8, No. 3, p 199-209, 1986. 4 fig, 1 tab, 23 ref.

Descriptors: *Education, *Training, *Groundwater pollution, *Water quality control, *Groundwater management, California.

The thesis that to attack groundwater pollution The thesis that to attack groundwater pollution problems it is necessary to train people thoroughly and thus develop the institutional capacity to solve problems is advanced. A case study is employed to show which disciplinary backgrounds are most needed, what level of preparation should be expected, what is the proper balance between depth in a discipline and breadth across the problem area. For the example (pollution from a solvent recovery and distribution facility in Gardens, California) the groundwater treatment with granular activated carbon, air stripping as an alternative, and treatthe groundwater treatment with granular activated carbon, air stripping as an alternative, and treatment costs are discussed. The typical preparation of students is outlined and recommended preparation of groundwater professionals is discussed. A wide spectrum of disciplinary knowledge is likely to contribute to efforts to build capacity with which to control ground water pollution. The greatest challenge, however, is to build a structure capable of integrating knowledge from various disciplinary areas toward problem solutions. (Rochester-PTT)

9D. Grants, Contracts, and Research Act Allotments

OVERVIEW OF GRANTS FOR SEWERAGE For primary bibliographic entry see Field 5D. W87-04809 **FACILITIES**

LOCAL FINANCE AND PO GROUNDWATER PROTECTION, Cornell Univ., Ithaca, NY. POLICY FOR

D. J. Allee. The Environmental 210-218, 1986. 29 ref. ental Professional, Vol. 8, No. 3, p

Descriptors: *Financing, *Government finance *Management planning, *Groundwater management, Water quality control, Risk management Drinking water, Local governments.

The general setting surrounding the state and local activities for the protection of groundwater is explored and an attempt is made to apply some of the concepts of public finance to the problems of natural resource management, a neglected branch of the institutional side of resource economics. The trai resource management, a neglected branch of the institutional side of resource economics. The author identifies some concepts for the evaluation of policy for federal and state programs intended to encourage more effective local action. State and federal programs will use a variety of fiscal devices to influence risk management. They must become a part of the trend toward innovative financing. New use of fees, credit enhancement devices, and targeted cost-aharing must be explored because of the major shifts that are occurring in public finance, especially as local governments are affected. Local governments have a strategic potential in increasing the nation's capacity to reduce the risk of groundwater contamination. They supply most of the drinking water provided in community systems and have a virtual monopoly on land use controls. They have many other advantages in closing the gaps in federal and state efforts. (Rochester-PTT)

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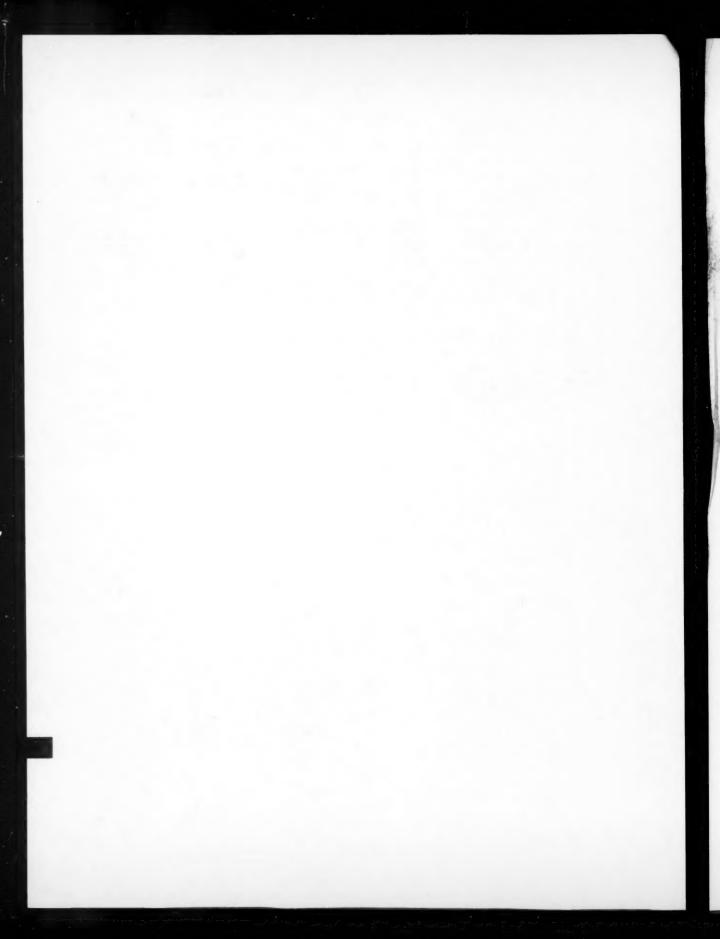
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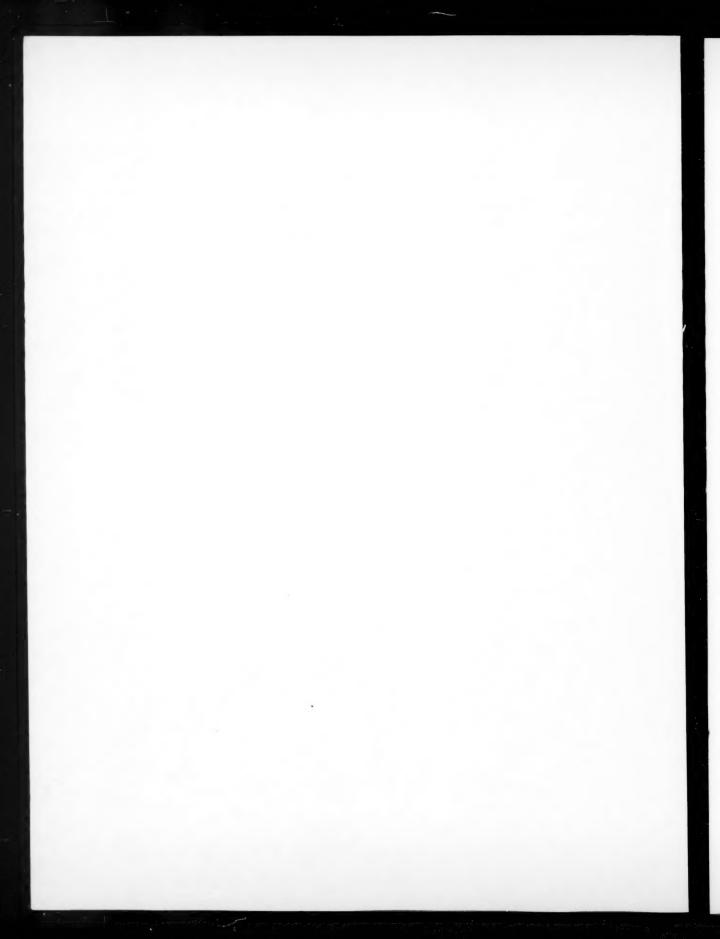
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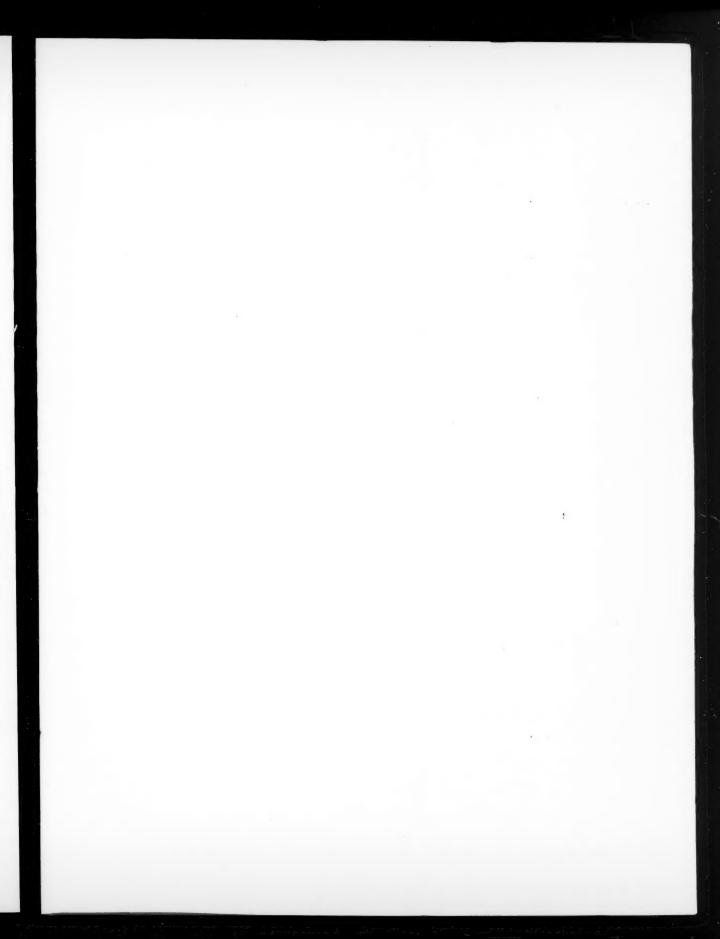
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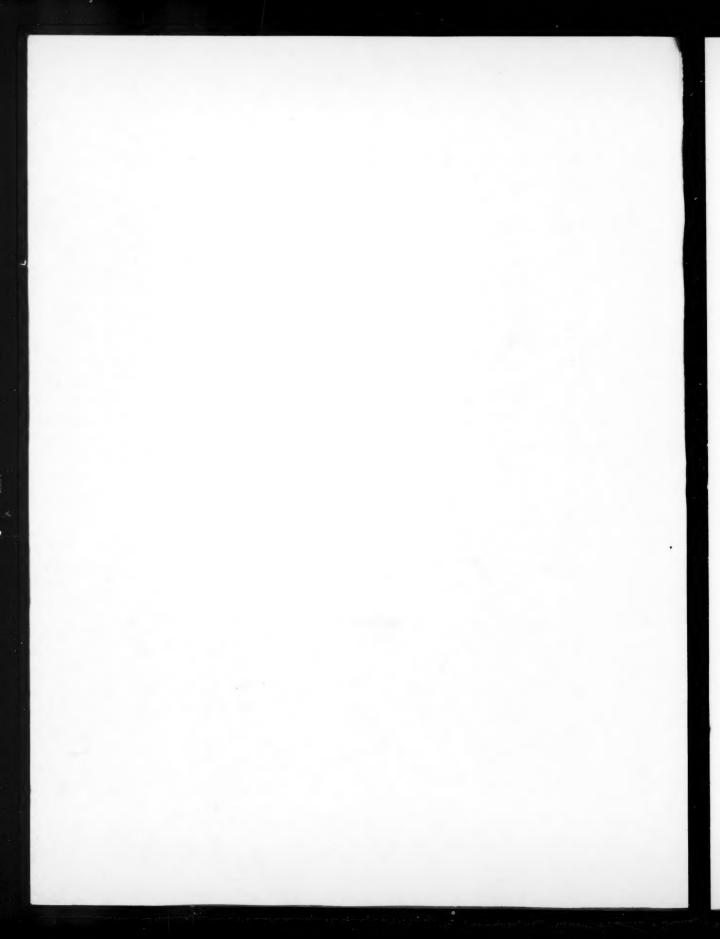
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A079.95	E0210.00	00775.00	T02175.00
A03 11.95	E0311.00	003 125.00	T03300.00
A04-A05 13.95	E0413.50	004 175.00	T04400.00
A06-A09 18.95	E0515.50	D05 225.00	T05500.00
A10-A1324.95	E0618.00	006 275.00	106600.00
A14-A1730.95	E0720.50	007 325.00	T07700.00
A18-A2136.95	E0823.00	000 375.00	T08800.00
A22-A2542.95	E0925.50	009 425.00	T09900.00
A99	£1028.00	010	T101,000.00
	E1130.50	011525.00	T111,100.00
	E1233.00	012 575.00	T121,200.00
WD145.00	E1335.50	D13	T131,300.00
NO248.00	E1438.50	D14 675.00	T141,400.00
	E1542.00	D15 725.00	7151,500.00
	E1646.00	D16 775.00	T161,600.00
	E1750.00	917 825.00	T171,700.60
	E1854.00	018 875.00	T181,800.00
	£1960.00	D19 925.00	T191,900.80
	E2070.00	D99*	T99
	F89 *		

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